SCIENTIFIC AMERICAN

WHENCE THE INDIAN?
By Dr. Ales Hrdlicka

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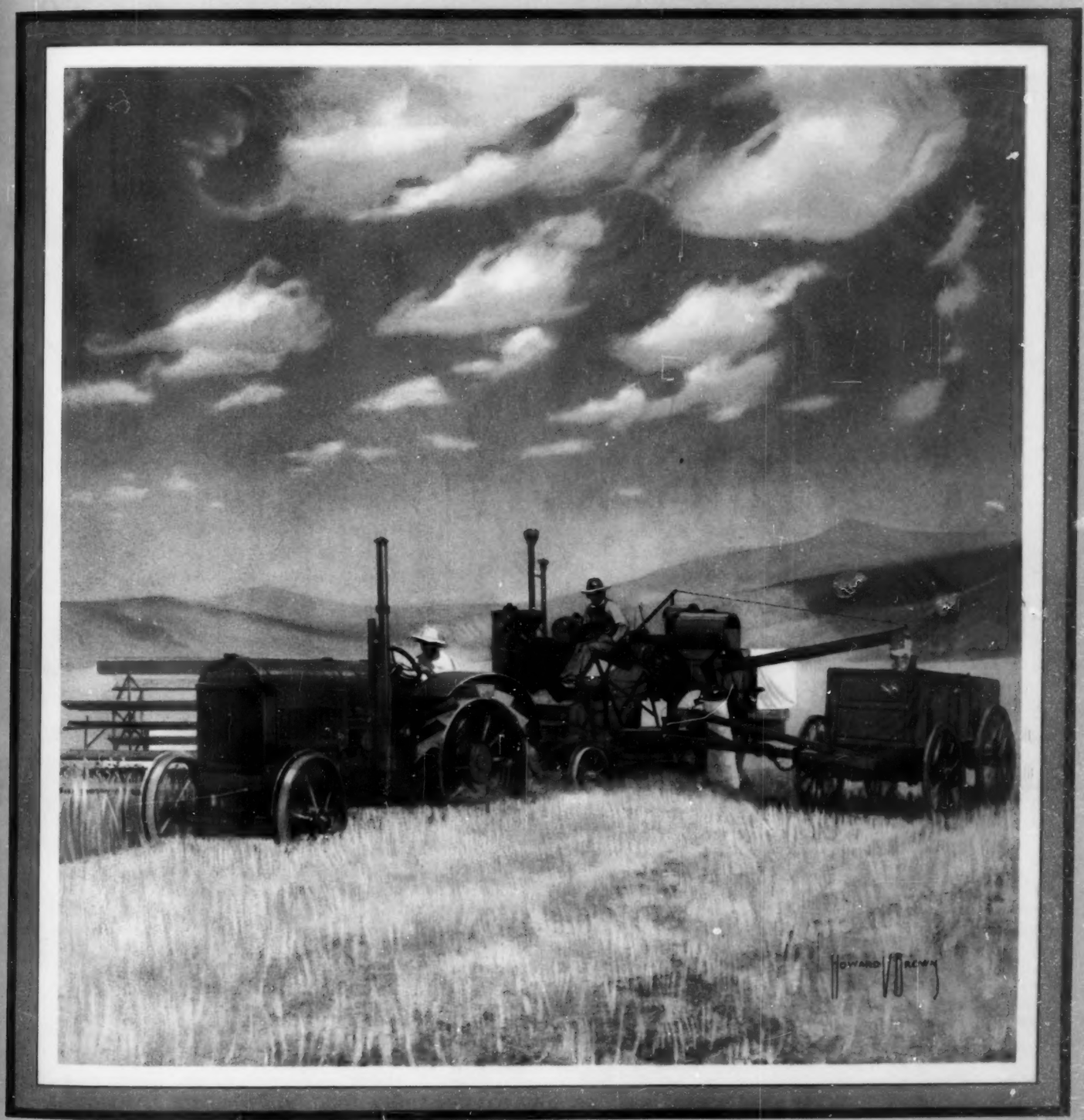
THE RIDDLE OF "PATIENCE WORTH"



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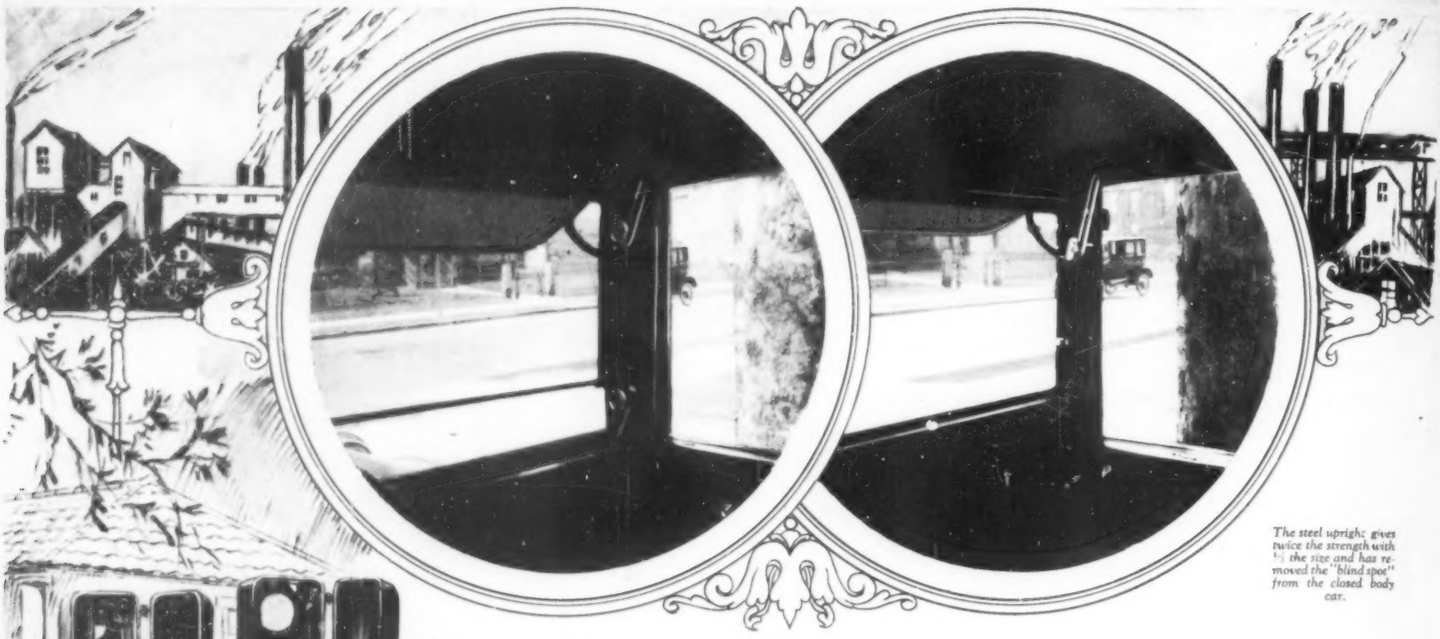

The steel upright gives twice the strength with ½ the size and has removed the "blind spot" from the closed body car.

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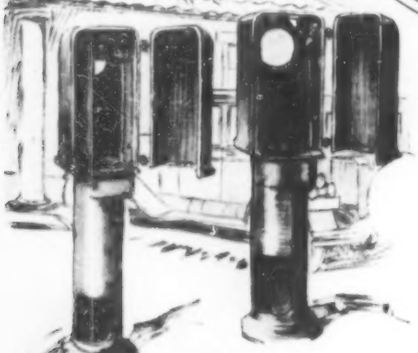
A Sheet Steel upright was designed which was twice as strong yet one third the size of the old type. Experts today freely predict that the time is coming when the "blind spot" will be outlawed from the road.

Many other products are suffering from similar "blind spots." Almost always they are regarded as essential. "It simply cannot be done differently." And then someone uses Sheet Steel. As one big fabricator puts it—"Anything can be made of Sheet Steel. It is practically only a question of production to justify the expense of design and dies."

If you have not considered the use of this material in connection with your product, it may pay you to give it careful thought. When you do this, try to free your thought from your present limits of construction. Remember Sheet Steel products may be made in two, three or more parts, and yet welded in the final assembly into an integral unit.



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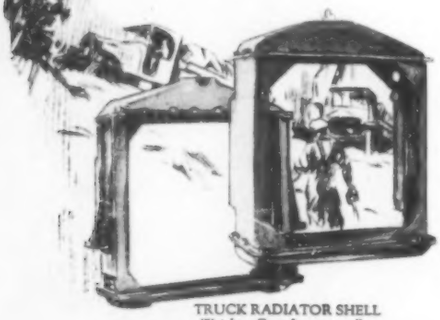
For years gasoline filling pumps were made with cast iron bases. Now these bases are made of Sheet Steel — lighter, stronger, and they ship without breakage.



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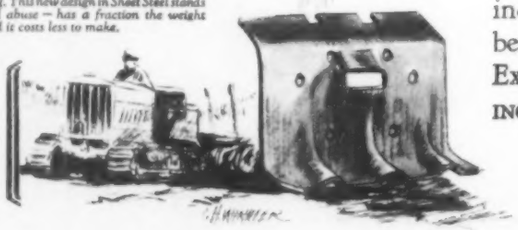

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SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, JULY, 1926 | *Edited by* ORSON D. MUNN | EIGHTY-SECOND YEAR

EXPANSION

WITH this issue the Scientific American becomes an eighty-page magazine. Heretofore it had seventy-two pages.

Why did we enlarge our journal? What motives?

Well, the real reason for the added pages is the fact that we have more things to tell you, about what is going on in the world of science and industry, than we can pack comfortably into seventy-two pages. The facts that the leaders of the world's thought are now writing for us are so important and so interesting that to trim these articles down so that they can be squeezed into seventy-two pages necessitates a sacrifice that we are unwilling to impose on either our authors or our readers. Then, too, articles you would enjoy have had to be put off from one issue to another on account of lack of space.

Oh, yes—the price? It remains the same.

$(9^9)^9$

LAST month we suggested to our readers that they figure out—and *write* out—the greatest number that can be indicated by means of three digits. A good many of them have made a fair start but nobody has sent us the correct answer as yet.

And there is a good reason why!

Nine to the ninth power, all to the power of nine, as expressed above, represents a number having some 369,693,000 odd digits, more or less. If one were to write digits at the steady rate of sixty per minute, and work ten hours a day, the whole number would be finished sometime in 1954, according to M. Laisant, of the *Ecole Polytechnique*, Paris.

Suppose we were to publish the number in the Scientific American, and filled each issue entirely with digits. Our readers would have the full result in 31 years.

Sorry, but we refuse to do it.

PROTECTION

ALL hail the passage of the Webb-Loomis medical bill in New York State. If this bill is enacted into law, it should have a far-reaching effect in the medical fraternity and in the curbing of quackery. The bill provides for the annual registration of all practitioners with the State Board of Medical Examiners and for the prevention of the use of the title "doctor" in a misleading manner. The registration lists will be open to the public at all times and so should prevent the gullible from being defrauded.

In This Issue

Who is Patience Worth?
That is one of the absorbing questions that must be answered before "The Riddle of Patience Worth," see page 20, can be solved. Read what Dr. Walter Franklin Prince has to say on this subject.

Whence Came the American Indian?
Careful researches conducted on the old stamping grounds of the Indians have produced no evidence that the race has long inhabited the plains and mountains of the Americas. In an article on page 7, Dr. Ales Hrdlicka has presented some facts that point toward a solution to this problem.

"Hello, London"—"Are You There, New York?"
These may not be unusual phrases in the near future, judging by the results so far achieved in transatlantic radio telephony. On page 30, Orrin E. Dunlap, Jr., tells how this is accomplished.

Does Moonlight Affect Plant Growth?
Old-fashioned farmers would plant certain crops only when, according to tradition, the phase of the moon was auspicious. Were they victims of superstition? Probably not, in view of the facts showing the relationship between polarized light and plant growth put forth by Prof. H. H. Sheldon on page 10.

The Atmosphere in Cross-Section
How high have sounding balloons been sent? How high do meteors flash? What are "noctiluscent" clouds, fifty miles up? How high is the aurora? What of Prof. Goddard's "moon-rocket"? See page 17.

MORE THAN 200 PICTURES

Complete table of contents will be found on page 80

For Next Month

How Earthquakes Are Located
The science of seismology is in its infancy. However the promise of an early maturity is encouraging. Today a chain of earthquake observatories encircles the globe. In our August issue Father Francis Tondorf will describe how a seismograph records the tremors of the earth's surface.

Golf Balls Studied Scientifically
The score that you make in golf does not depend entirely on your skill. The construction of the ball used is of vital importance. Prof. H. H. Sheldon will show how the desirable characteristics can be determined experimentally.

Imagine an Island of Silver!
Catalina, an island off the coast of California, is now being intensely mined for its valuable ore, yet the mining operations are not interfering with the pleasure resort possibilities.

Other articles on, The Jade of Mexico and Central America; The Salt Miners of Nevada; The Manufacture of Rayon; Training Parachute Jumpers; Conservation; Our New Airplane Carrier, the S. S. Saratoga; Radio; Astronomy.

MORE THAN 200 PICTURES

COMPLAINT

DOUBTLESS, many of our readers will be sympathetically disposed to the statement of Mr. T. J. Kennedy, Chairman of the Cold Rolled Press and Copper Association, when he makes a plea for the use of simple language in the reports of research workers. Speaking at an annual luncheon in Birmingham, England, he said that some of these reports—though doubtless of great value—were, because of what he calls their scientific "jargon," as unintelligible to the average business man as they would be if they were addressed to him in Russian. He objected to the tendency to "label a characteristic with some new name rather than to resolve it in terms of familiar conceptions." The terms used in scientific research are based largely—almost exclusively—upon Latin or Greek originals; and hence this complaint should find a sympathetic hearing in this country, where there is a tendency to omit classical studies from the curricula of our schools and colleges.

ROTORSHIPS

WE have just come from circumnavigating New York harbor in Herr Anton Flettner's famed rotorship *Baden-Baden*. There is no doubt about it, the new vessel performs well. But will it be an economic success? There is the crux of the matter, and there is no way to find out except to try one in actual commerce. Purely scientific interest does not weigh much with ship owners. Dollars do.

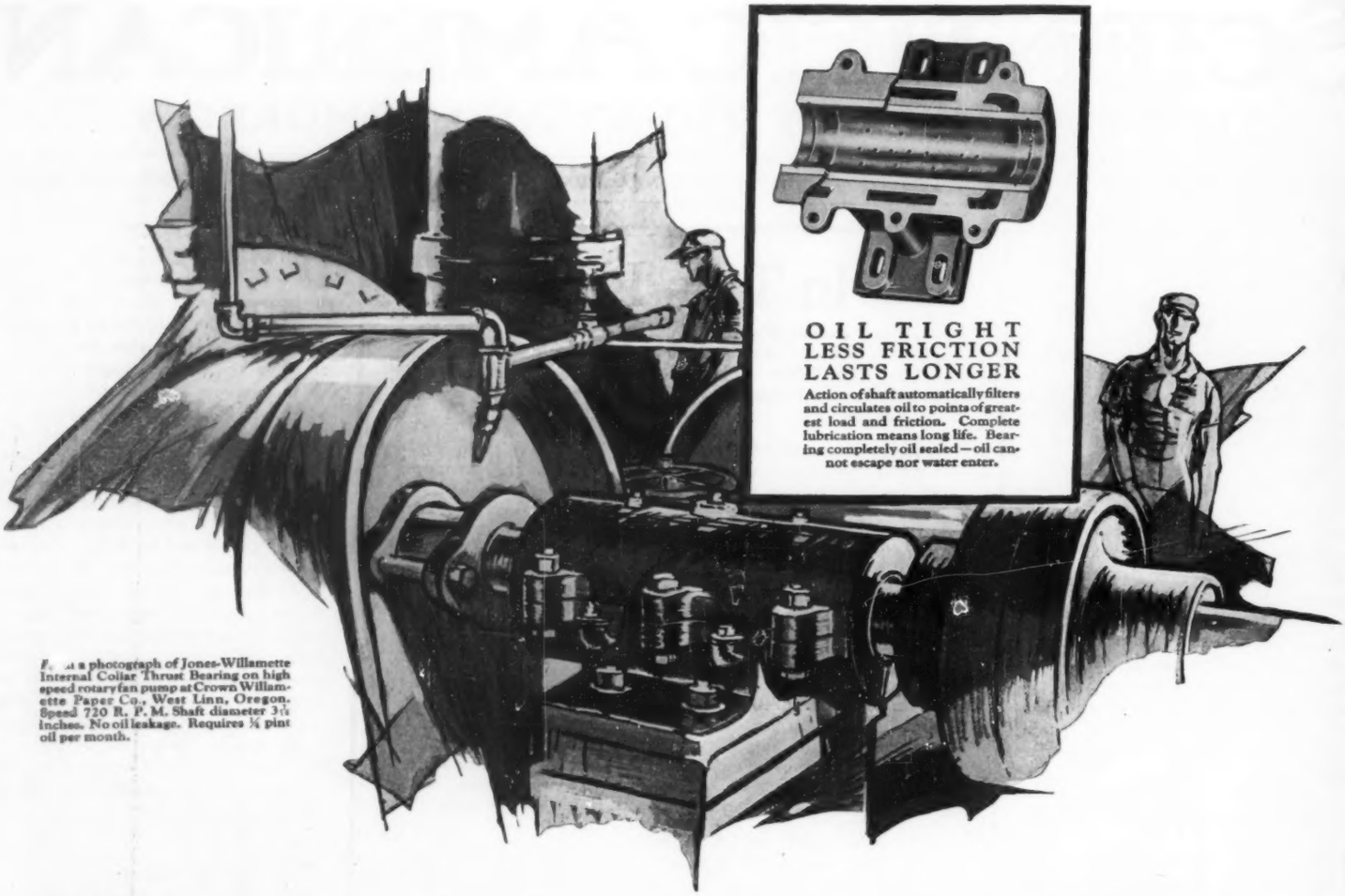
Many of the things that have been said about the rotorship do not apply. Its inventor does not expect it either to supplant steam or bring a return to wind navigation. It is itself to become an auxiliary to steam. In that capacity it should save fuel.

PLANES

PERFECT flatness is an ideal which scientists admit is almost impossible to attain. However, the Bureau of Standards has come near it, producing a surface which deviates only one-five millionth of an inch.

This has been accomplished by producing a "master quartz flat" which, it is predicted, will supplant the glass flats previously used in testing micrometers and other gages used by manufacturers. The fault of the glass flat, it is explained, lies in the fact that it is expanded by heat.

This is only another one of innumerable cases in which industry has had to look to science for its own advances.



From a photograph of Jones-Willamette Internal Collar Thrust Bearing on high speed rotary fan pump at Crown Willamette Paper Co., West Linn, Oregon. Speed 720 R. P. M. Shaft diameter 3½ inches. No oil leakage. Requires ¼ pint oil per month.

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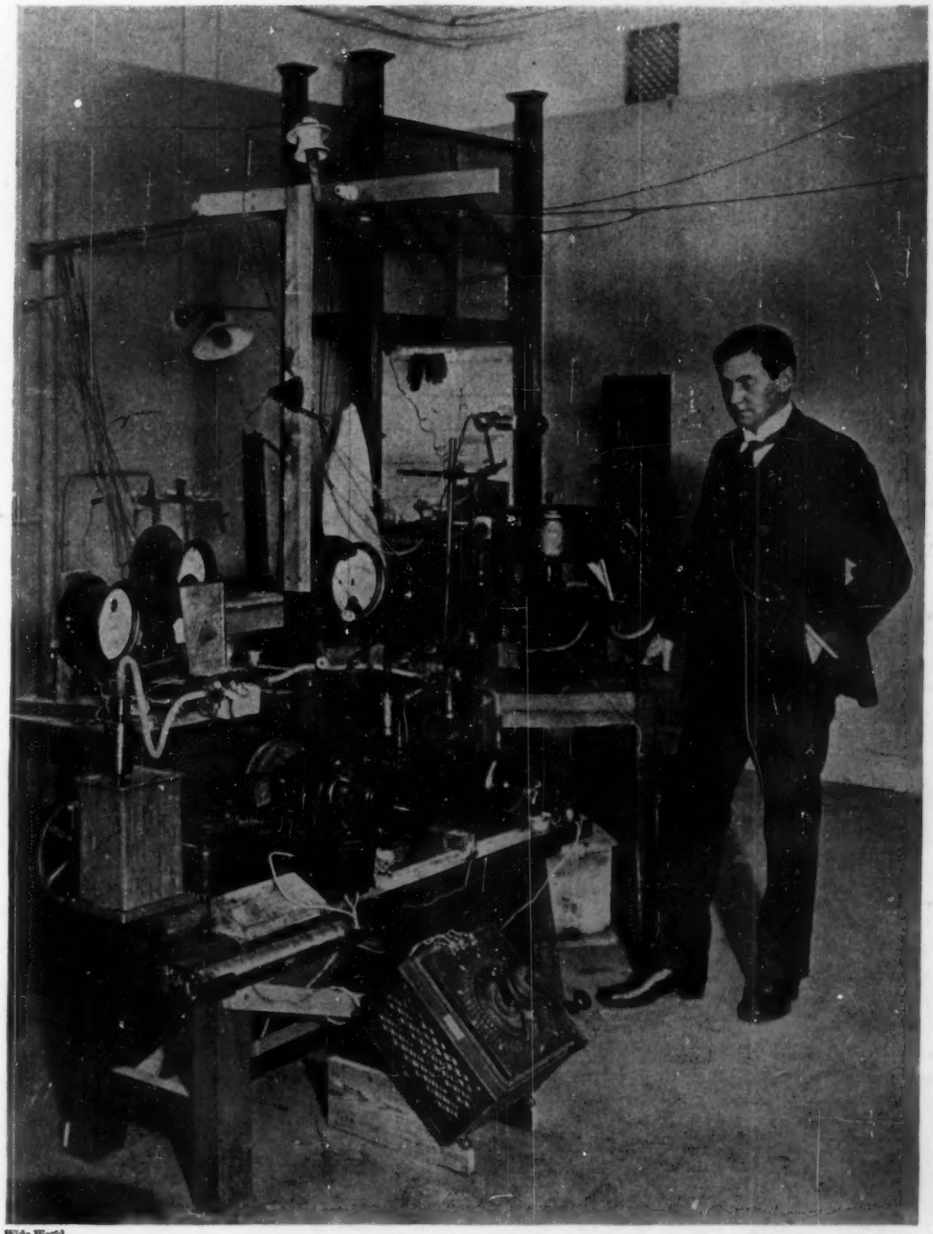
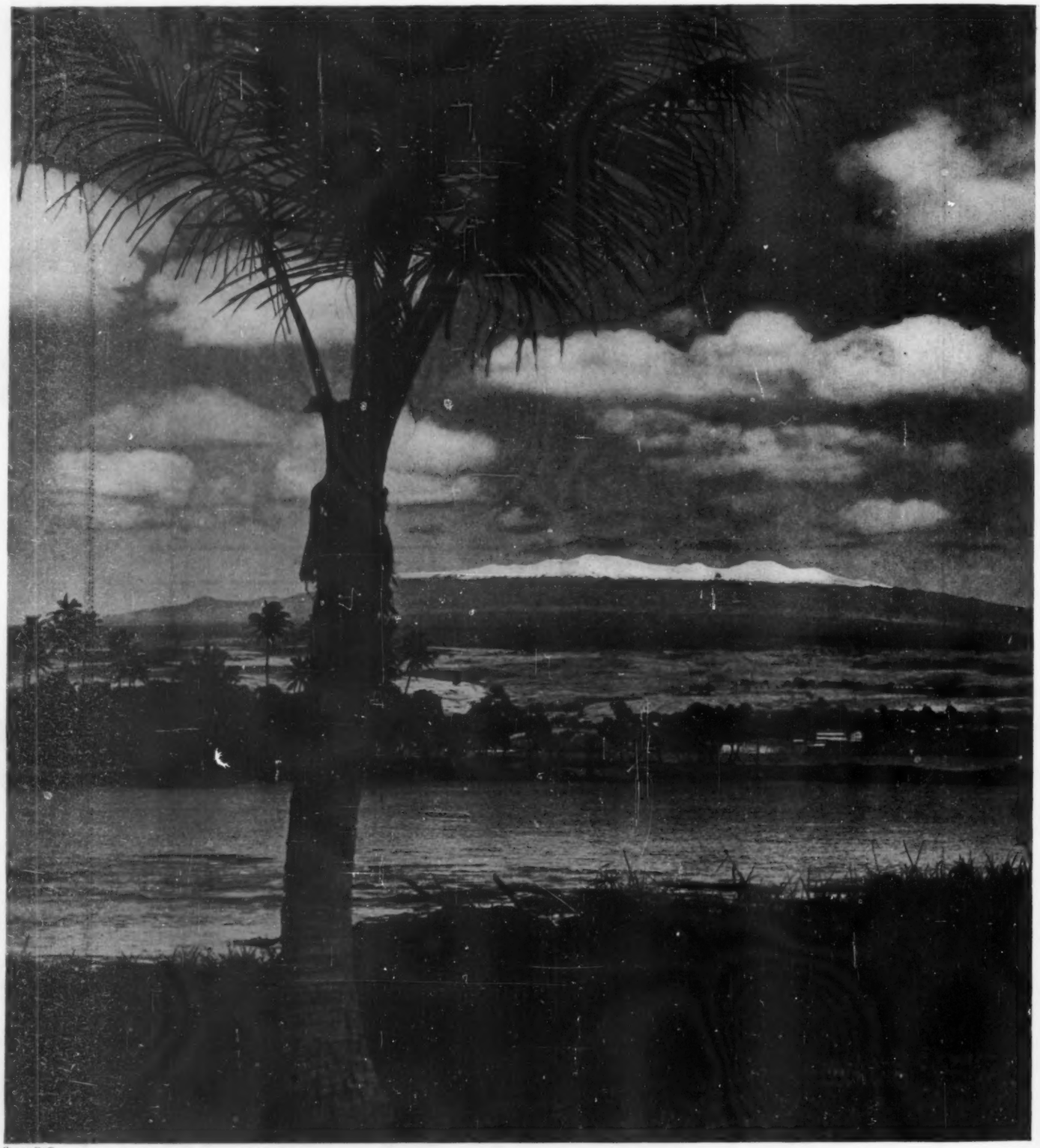


Wide World

HELPS TO IDENTIFY NEW ELEMENTS

For his notable researches in X-ray spectroscopy, Prof. Manne Siegbahn, Professor of Physics at the University of Upsala, Sweden, has been awarded the postponed 1924 Nobel Prize for Physics. His work permits us to measure the extremely short wavelengths in the X-ray region of the spectrum with much closer accuracy than ever before; while his study of the soft radiations that lie between the ultra-violet and X-ray region of the spectrum "have made possible," says NATURE *(London), "the theoretical work on which practically all our knowledge of the distribution and energy properties of the electrons in the atoms is based." This data led to the recent identification of three new elements. If the periodic law holds good, all but two of the elements have now been discovered*

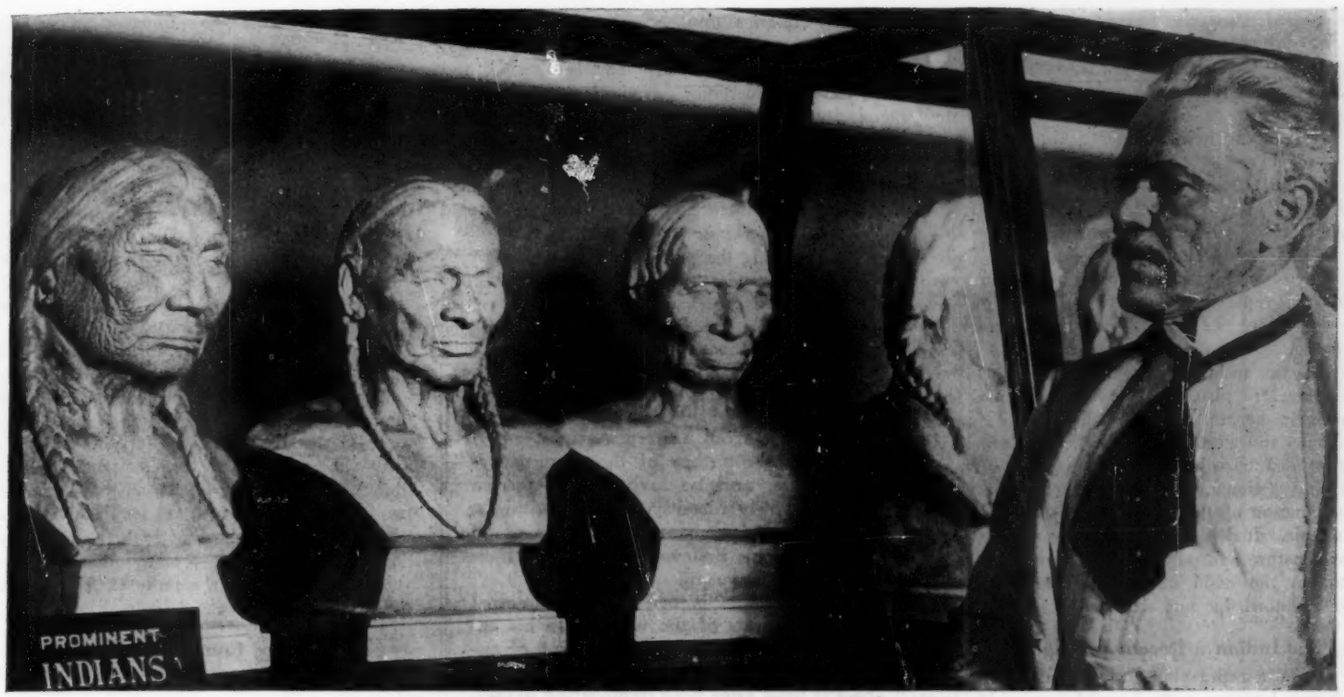


Camera Craft

Mauna Loa Active Again

Since 1919, the Hawaiian volcano, Mauna Loa, has been nearly dormant, showing only occasional sparks of life in the form of discharges of gases and bubblings of lava in the crater. Recently, however, the formation of molten rock increased until finally it overflowed through a crack in the mountainside and a sluggish stream slowly wended its way toward the sea. A volcanic eruption of this sort is not dangerous to the populace as the lava stream in this case moved at a speed of only about five miles a day, allowing ample time for the inhabitants to move from its path. Much property was destroyed, but general economic conditions suffered little and in the majority of cases business continued.

Our illustration shows a view of Mauna Loa and Mauna Kea, a sister peak, as seen at a time of inactivity from the harbor of Hilo, Hawaii. Mauna Lao, the left peak, is 13,695 feet high. In the illustration it appears to be much lower than this, due to the distant perspective and because the land surrounding it slopes upward gradually, a fact not apparent in the picture and one that is deceiving to the eye.



DR. HRDLICKA HAS MADE THE STUDY OF MAN'S ANATOMY HIS LIFE WORK

The Race and Antiquity of the American Indian

There Is No Valid Evidence that the Indian Has Long Been in the New World

By Dr. Ales Hrdlicka

Curator of the Division of Physical Anthropology, United States Museum, Smithsonian Institution

WHEN Columbus and his followers reached the Antilles and later the mainland of America, they found both the islands and the land peopled in all their habitable parts. And they found them peopled by a variety of man that, while differing in details, showed, nevertheless, so much in common that they comprised him collectively under the term "Indian."

History tells that, as no mention was made concerning the American natives in the Scriptures, many of the early Spaniards, up to Las Casas' time, reached the conclusion that they could not be regarded as men equivalent to those named in biblical accounts. This view, which eventually had to be counteracted by a special papal bull, led to wholesale enslavement and destruction of the Indians.

The effect of the papal edict which established the American aborigines as true men was that thenceforth their origin was sought in other parts of the world, and the seeming necessity of still harmonizing this origin with biblical records led eventually to some curious opinions. One of these was to the effect that the American aborigines must be the descendants of the Canaanites who were expelled from their original abode by Joshua; another was that they were descended from Asiatics who themselves originated from Magog, the second son of Japhet; but the most widespread theory, and one with the remnants of which we meet to this day, was that the American Indians represented the so-called Lost Tribes of Israel. Lord Kingsborough died in bankruptcy through costly publications in which he tried to prove this opinion.

During the course of the Nineteenth Century, with Levêque, Humboldt, McCullogh, Morton and especially Quatrefages, we begin to encounter more rational hypotheses concerning the origin and racial identity of the "Indians;" but the individual views differ widely. For some the Indian is "autochthonous," that is, he originated somehow in the New World; while for others he has been wholly or partly derived from the Asiatics, or the Phoenicians, Egyptians, Ethiopians, the Welsh, the Irish or still others. The erudite Dr. McCullogh believed that the Indians originated from parts of different peoples who reached America over lost land from the west, "when the surface of the earth allowed a free transit for quadrupeds." Quatrefages viewed the Americans as a conglomerate people, resulting from the fossil race of Lagoa Santa, the race of Paraná, and probably others, in addition to which he believed that in Southern California and perhaps elsewhere there had been settlements of Pacific Islanders. Nevertheless, the majority of the authors of the last century believed that the American natives were all of one main race and that they were derived from northeastern Asia, particularly from the "Tartars," or Mongolians.

Opposing Theories About the Indian

The most recent students of the question agree that this country was peopled through immigration and local multiplication of people; but the locality, nature, and unity or plurality of the immigration or immigrations are still moot questions. While most students incline to the exclusively northeastern Asiatic origin, others, such as the French ethnologist Rivet, show on linguistic grounds a tendency to follow Quatrefages in attributing at least some parts of the native American population to Melanesians, Polynesians and even Australians.

With the general conviction that the Indian was an immigrant into the New World, there necessarily followed speculation as to his antiquity on this continent; and there were always, and are today, many who believe that man must have been in America a great length of time. Such a notion is stimulating and therefore attractive. Moreover it seems to be substantiated by the great diversity of the American languages, and by various finds which appear to point to man's co-existence here with extinct animals. Charcoal, arrow-points, fragments of pottery and even human bones have been found in association or in the same strata with the bones of the mastodon, fossilized buffalo, the glyptodon and other extinct creatures; or again in deep deposits of apparently great age.

Moreover there are found from time to time human skulls and bones that have been petrified and even enclosed in rock. And there are the many unquestionably ancient relics in other parts of the world to which, some students feel, there ought to be some parallel in this hemisphere. It is little wonder that under these circumstances a belief in the geological antiquity of man in America should be found even with some reputable scientific men, particularly some of the older and again of the young generation, and among workers in collateral lines such as linguistics, geology and paleontology.

The actual status of opinion as to the Indians' origin, racial composition and antiquity on this continent, may briefly be summarized as follows:

1. The Indian originated outside of this continent and is therefore an immigrant into it. On this point there is no longer any division of opinion.

2. As to his racial composition there are two main views. The more general one is that the In-

dian, notwithstanding the long-recognized presence among him of several more or less distinct types, is nevertheless essentially of one race, the yellow-brown, whose old home was northern Asia. A secondary opinion, spreading most recently again from France and finding here and there individual protagonists, is that the American man, while he is mainly of north-Asiatic and yellow-brown descent, comprises also various other racial contingents, from the Pacific, from Australia; to which some feel inclined to add Europe and the region of the Mediterranean. These latter opinions are supported on one hand by apparent or real resemblances of linguistic character, and on the other by similarities of some American with other crania.

3. As to the antiquity of the Indian in the New World, there are also two lines of opinion. The first and more general is, briefly, that such antiquity is moderate and post-glacial; the other, which is but hazily defined, places the coming here of man farther, and at times very much farther, backwards. The explanation of this diversity of views is relatively simple. It depends partly on the peculiarities of human nature and partly on differences in training, but in the main on the varying individual degrees of knowledge and experience.

The Indian a Recent Immigrant

Let us take a rapid glance at the principal facts which have a bearing on these problems, considering first the racial question and then that of antiquity.

In the racial problem the main word belongs naturally to physical anthropology which deals with the least mutable parts of man, namely his body and skeleton. Our knowledge of the Indian has now advanced so far that a number of important generalizations concerning him are possible. There are now at our disposal for comparison, in American museums alone, upwards of twenty thousand Indian crania and skeletons from all parts of the continent.

In the light of present knowledge concerning the American native, what can be stated with a fair degree of positiveness is that, first, there is no biological evidence or any probability, that man originated on this continent; second, that man did not reach America until after he had attained a development superior to that of even the latest glacial (upper Neanderthal) man in Europe, and after having undergone advanced stem and even racial and tribal differentiation; and third, that while the American man, since the peopling of this continent was initiated, has developed here numerous secondary subracial localized modifications, these modifications have in no basic feature obliterated the original general or stem type..

Notwithstanding the presence of several subtypes and various secondary physical modifications, the American Indian presents certain fundamental features in common which mark him plainly as of one race, in a broad sense of the word. These features are:

The color of the skin. The color of the Indian differs, according to localities, from yellowish-brownish to that of the brown of solid chocolate; the basic color is brown.

The hair of the full-blood Indian from one end of the continent to the other is black and straight, his beard is scanty, especially on the sides of the face, and is never long. There is little or no hair on the body except in the axillae (armpits) and on the pubis, and even there it is sparse. The hair is invariably black from birth on.

The eyes as a rule are dark brown. The conjunctivae are blue in childhood, yellowish in adults. The eye slits show a prevailing tendency, which is more or less noticeable in different tribes, to a slight slant, that is, the external corners are frequently appreciably higher than the internal. But the epicanthus (fold over the inner corner of the eye), while frequent in childhood, disappears later in life. The supraorbital ridges (above the eyes) are on the average more developed than in whites; but the glabella (space between the eyebrows) is not prominent or bulging and does not overhang the nasal root depression as in the Australian.

The nasal bridge in the men is well developed, and the nose in the living, as well as the nasal aperture in the skull (barring individual exceptions), tend to medium relative proportions. The important detailed features of the nasal aperture and spine are of the type that prevails in the yellow-brown stock. The malar (cheek bone) regions are as a rule larger or more prominent than they are in civilized whites.

The mouth is rather large, the lips medium to somewhat fuller than in whites, the alveolar region (the parts of the jaws in which the teeth are set) are somewhat more prognathic, or protrusive. The lower jaw is strong, chin well developed, teeth frequently larger than in whites. The upper incisors of the Indian throughout the continent are characteristically "shovel-shaped," that is, deeply and peculiarly concave on their lingual side. The ears are large.

The neck is never long and thin. The chest is deeper than in average whites. The breasts of the women are regularly of a good medium size and generally more or less conical in form. There is a complete absence of steatopygy, or excess development of the buttocks. The lower limbs are less shapely than in whites; the calf is smaller.

The hands and feet, as a rule, are of relatively moderate or even small dimensions and, what is among the most important of the characteristics, the relative proportions of the forearms to arms and those of the distal parts of the lower limbs to the proximal (or, in the skeleton, the radio-humeral and tibio-femoral indices) are in general, throughout the two parts of the continent, of similar average values, which differ from those of both the whites and the negroes, standing, like so many other features of the yellow-brown stock, in a more or less intermediary position.

Other Comers Assimilated

The Indian is free from characteristic odor. His normal heart-beat, except possibly in some parts of the tropics, is slow. His mental characteristics are much alike. The size of the head and of the brain cavity is comparable throughout, averaging somewhat less than in white men and women of similar stature.

This list of characteristics which are shared by all the American natives could be further extended, but the common features already mentioned should suffice. They speak convincingly for the fundamental racial unity of the Indians.

In this general Indian type there are, it may be reiterated, group, as well as individual, differences in color, stature, head form and facial features. But these differences are no greater than those that are found in the white race, or in the rest of the yellow-browns or in the blacks; and they are always

Whence Came the Indian?

He came from eastern Asia, says Dr. Hrdlicka, the author of the accompanying article, and he arrived in America comparatively recently, that is, within a few thousand years—and not, as many would have us believe, hundreds of thousands of years ago.

Dr. Hrdlicka is one of the foremost anthropologists of the world. In his capacity as head of the department of anthropology at the Smithsonian Institution he has time after time demolished unwarranted claims for the extreme antiquity of man in America.

In recognition of his important work the coveted Huxley Medal has just been awarded to Dr. Hrdlicka, and he will therefore go to England to receive this honor, and to lecture before the Royal Anthropological Institute.

BHUTIA WOMAN, DARJEELING, NEAR TIBET

Of Mongoloid stock, she resembles the American Indian, in facial and other physical characteristics, yet her home is many miles from America

TIBETAN WOMAN FROM THE HIMALAYAS

Her face and features are those of a typical Apache Indian of the American continent. Her ancestors probably immigrated via a now sunken land

IS THIS AN AMERICAN INDIAN?
One might easily think so, yet he is a southern Tibetan

associated with numerous other characteristics that brand every American aborigine indelibly as an "Indian." In no place and at no time has a normal, full-blood Indian been found who was or could be claimed as anything else than an Indian.

If the unmixed American aborigine is considered on the basis of all the data, both on the living and on the skeletal parts, the only conclusion that appears possible is that, though presenting a number of subtypes and a good range of individual or localized differences, yet fundamentally he belongs to but one large strain of humanity. This is the yellow-brown stem, which includes the Mongol, the Malay, the Eskimo, with a large element in the Chinese, Japanese, Tibetans and the aboriginal Siberians, and more or less of whose blood runs also in the Polynesians.

This does not mean that there have been no accessions to the American stock in pre-Columbian times. It is well known that long before Columbus some Scandinavians reached Greenland, and after that reached the "Vineland," which was probably the coast of New England. It would also be hard to believe that no isolated vessels have in the course of ages reached the continent from other parts of the world, both across the Atlantic and the Pacific. But such necessarily small parties of men, while capable, if preserved, of influencing a local culture and possibly even the language, would soon disappear through amalgamation and after a few generations would leave no substantial trace of their coming.

So much as to race. We may now consider the question of antiquity.

The criteria of antiquity, in the case of man, are in the main: Adaptation and diversification; and remains of the earlier man—remains of the animals on which he fed, of the stone and other utensils he made, of the refuse of his stone industry, of his fires and habitations, of his higher arts, and finally those of his own skeleton. There are endless examples of all this in the Old World, particularly in Europe. There are whole "cemeteries" of the bones of mammoths (Moravia), of the ancient horse (Solutré), of the buffalo, reindeer, etc. (southern France). The sites of ancient man in western and parts of central Europe are so numerous that they can hardly be numbered. The industrial (stone implement) remains of early man in France alone are rich enough plentifully to supply all the museums of the world. Individual sites in England, the Channel Islands, Belgium, France, Spain, Moravia, have given prehistoric implements and rejects reaching up to tens of thousands; and there is no old cave in the regions occupied by early man that does not yield evidences of his presence ranging from substantial to rich. Besides which there is not now a year in those parts of the world but there are discovered the skeletal remains of man of antiquity himself, remains which, except in the latest and postglacial phases of prehistory, show a man progressively, as we go back in time, of more primitive features.

Let us contrast America. Not a single skull or skeleton of a lower or other type than that of the Indian. Not one cave with old art on its walls; not one to this day that has shown the presence of pre-Indian habitation. Not a single refuse heap or habitation site with ancient bones or implements. Notwithstanding the life works of Putnam, Thomas, Clarence B. Moore, Holmes, Fewkes, Hough, Morehead, Mills and many others, not a scrap of a bone or implement that can generally and with full confidence be accepted as geologically ancient. Also not a single discovery by non-anthropologists that has so far stood the test of critique or that can show more than Indian-like implements, Indian-like pottery, Indian-like skull or bones, or such an association with *really* old animal remains that could definitely exclude the possibility of chance.

It is self evident that if man had existed on this continent during the glacial times or before the Indian, he would have been here in numbers, and being gregarious he would have lived in groups. But a family or clan or a tribal group, even if nomadic, is bound to leave ample witnesses of its existence in the form of refuse, of animal bones, of stone workings, if nothing further. Where are these witnesses in the New World? And aside, how could man have reached here during glacial times? Where are his traces on the road, and in eastern Asia? What could he have been derived from, and what has become of him?

Sources of Error

It must be evident even to the non-scientist that not until all these questions can be satisfactorily answered may American science accept as a fact the presence here of any geologically ancient (glacial or pre-glacial) man, preceding the Indian, and they are not being answered.

As to the coming of the Indian, it could have been no regular, stream immigration, but only a dribbling over from northeastern Asia, extending probably over a long stretch of time; and the successive contingents must necessarily have brought with them differences in language and even in physique, which doubtless account for at least a certain proportion of the Indian linguistic stocks, as well as for several of his more marked physical types.

As to the antiquity of the Indian himself, that cannot be very great. He has passed here through

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Tibetan, but she might as easily come from an Indian reservation in the United States

ANOTHER INDIAN TYPE FROM TIBET
Replace his queue with feathers. What would you call him?

no gradation of cultural stages. He has become differentiated here into no markedly different physical groups geographically, notwithstanding the fact that he extends from the arctic to the tropics and again to the antarctic, and from the high sierras to the low sea coasts. Throughout he presents a stage of physical development that belongs to the era of post-glacial and recent man. And scattered over a large part of eastern Asia, he still has living relatives who are still so close to his type that if they were mingled with him and dressed in his way they could not possibly be separated as something different.

That Indian bones, potsherds or implements have been found in greater or less of association with bones of the mastodon, the giant armadillo and other extinct animals, may readily be conceded. That they will be found in such associations even more frequently in the future, if excavations extend, is certain. But such association alone is of doubtful value. It is not yet known just how late some such animals survived; but regardless of their antiquity, the presence with them or even beneath some of them, of human remains does not necessarily mean contemporaneity. Here is where many are misled. Except in secondary accumulations an animal bone found with another animal bone may safely be assumed, in the majority of cases at least, to be of the same age. But with human remains, particularly human bones, there enters into the case a most important, most disturbing and practically constant factor, which is human instrumentality. Since the early Neanderthal times, at least, man has *buried* his dead, or what may have been left of them after temporary exposure. And he buries two to seven feet deep, into any strata that he can penetrate. In this manner he introduces his remains into different associations, and bones of fossil forms may even come to lie above the human. Hundreds of years of settling, brought about through seepage and other processes in the ground, will in many cases obliterate the disturbance; due to the components of the soil or waters, the bones may meanwhile fossilize more or less, in the same manner as older inclusions; and thus the trap is beautifully set for another "tertiary" or "glacial" man in the eyes of the more enthusiastic than experienced and wary observer.

Taking everything into consideration we may therefore still hold legitimately that the presence on the American continent, north or south, of beings older than or different from the Indian, has not been established; and that according to all indications the antiquity here of the Indian himself is moderate, post-glacial and probably post-Aurignacian.

dian, notwithstanding the long-recognized presence among him of several more or less distinct types, is nevertheless essentially of one race, the yellow-brown, whose old home was northern Asia. A secondary opinion, spreading most recently again from France and finding here and there individual protagonists, is that the American man, while he is mainly of north-Asiatic and yellow-brown descent, comprises also various other racial contingents, from the Pacific, from Australia; to which some feel inclined to add Europe and the region of the Mediterranean. These latter opinions are supported on one hand by apparent or real resemblances of linguistic character, and on the other by similarities of some American with other crania.

3. As to the antiquity of the Indian in the New World, there are also two lines of opinion. The first and more general is, briefly, that such antiquity is moderate and post-glacial; the other, which is but hazily defined, places the coming here of man farther, and at times very much farther, backwards. The explanation of this diversity of views is relatively simple. It depends partly on the peculiarities of human nature and partly on differences in training, but in the main on the varying individual degrees of knowledge and experience.

The Indian a Recent Immigrant

Let us take a rapid glance at the principal facts which have a bearing on these problems, considering first the racial question and then that of antiquity.

In the racial problem the main word belongs naturally to physical anthropology which deals with the least mutable parts of man, namely his body and skeleton. Our knowledge of the Indian has now advanced so far that a number of important generalizations concerning him are possible. There are now at our disposal for comparison, in American museums alone, upwards of twenty thousand Indian crania and skeletons from all parts of the continent.

In the light of present knowledge concerning the American native, what can be stated with a fair degree of positiveness is that, first, there is no biological evidence or any probability, that man originated on this continent; second, that man did not reach America until after he had attained a development superior to that of even the latest glacial (upper Neanderthal) man in Europe, and after having undergone advanced stem and even racial and tribal differentiation; and third, that while the American man, since the peopling of this continent was initiated, has developed here numerous secondary subracial localized modifications, these modifications have in no basic feature obliterated the original general or stem type..

Notwithstanding the presence of several subtypes and various secondary physical modifications, the American Indian presents certain fundamental features in common which mark him plainly as of one race, in a broad sense of the word. These features are:

The color of the skin. The color of the Indian differs, according to localities, from yellowish-brownish to that of the brown of solid chocolate; the basic color is brown.

The hair of the full-blood Indian from one end of the continent to the other is black and straight, his beard is scanty, especially on the sides of the face, and is never long. There is little or no hair on the body except in the axillae (armpits) and on the pubis, and even there it is sparse. The hair is invariably black from birth on.

The eyes as a rule are dark brown. The conjunctivae are blue in childhood, yellowish in adults. The eye slits show a prevailing tendency, which is more or less noticeable in different tribes, to a slight slant, that is, the external corners are frequently appreciably higher than the internal. But the epicanthus (fold over the inner corner of the eye), while frequent in childhood, disappears later in life. The supraorbital ridges (above the eyes) are on the average more developed than in whites; but the glabella (space between the eyebrows) is not prominent or bulging and does not overhang the nasal root depression as in the Australian.

The nasal bridge in the men is well developed, and the nose in the living, as well as the nasal aperture in the skull (barring individual exceptions), tend to medium relative proportions. The important detailed features of the nasal aperture and spine are of the type that prevails in the yellow-brown stock. The malar (cheek bone) regions are as a rule larger or more prominent than they are in civilized whites.

The mouth is rather large, the lips medium to somewhat fuller than in whites, the alveolar region (the parts of the jaws in which the teeth are set) are somewhat more prognathic, or protrusive. The lower jaw is strong, chin well developed, teeth frequently larger than in whites. The upper incisors of the Indian throughout the continent are characteristically "shovel-shaped," that is, deeply and peculiarly concave on their lingual side. The ears are large.

The neck is never long and thin. The chest is deeper than in average whites. The breasts of the women are regularly of a good medium size and generally more or less conical in form. There is a complete absence of steatopygy, or excess development of the buttocks. The lower limbs are less shapely than in whites; the calf is smaller.

The hands and feet, as a rule, are of relatively moderate or even small dimensions and, what is among the most important of the characteristics, the relative proportions of the forearms to arms and those of the distal parts of the lower limbs to the proximal (or, in the skeleton, the radio-humeral and tibio-femoral indices) are in general, throughout the two parts of the continent, of similar average values, which differ from those of both the whites and the negroes, standing, like so many other features of the yellow-brown stock, in a more or less intermediary position.

Other Comers Assimilated

The Indian is free from characteristic odor. His normal heart-beat, except possibly in some parts of the tropics, is slow. His mental characteristics are much alike. The size of the head and of the brain cavity is comparable throughout, averaging somewhat less than in white men and women of similar stature.

This list of characteristics which are shared by all the American natives could be further extended, but the common features already mentioned should suffice. They speak convincingly for the fundamental racial unity of the Indians.

In this general Indian type there are, it may be reiterated, group, as well as individual, differences in color, stature, head form and facial features. But these differences are no greater than those that are found in the white race, or in the rest of the yellow-browns or in the blacks; and they are always

Whence Came the Indian?

He came from eastern Asia, says Dr Hrdlicka, the author of the accompanying article, and he arrived in America comparatively recently, that is, within a few thousand years—and not, as many would have us believe, hundreds of thousands of years ago.

Dr. Hrdlicka is one of the foremost anthropologists of the world. In his capacity as head of the department of anthropology at the Smithsonian Institution he has time after time demolished unwarranted claims for the extreme antiquity of man in America.

In recognition of his important work the coveted Huxley Medal has just been awarded to Dr. Hrdlicka, and he will therefore go to England to receive this honor, and to lecture before the Royal Anthropological Institute.

BHUTIA WOMAN, DARJEELING, NEAR TIBET

Of Mongoloid stock, she resembles the American Indian, in facial and other physical characteristics, yet her home is many miles from America

TIBETAN WOMAN FROM THE HIMALAYAS

Her face and features are those of a typical Apache Indian of the American continent. Her ancestors probably immigrated via a now sunken land

IS THIS AN AMERICAN INDIAN?
One might easily think so, yet he is a southern Tibetan

associated with numerous other characteristics that brand every American aborigine indelibly as an "Indian." In no place and at no time has a normal, full-blood Indian been found who was or could be claimed as anything else than an Indian.

If the unmixed American aborigine is considered on the basis of all the data, both on the living and on the skeletal parts, the only conclusion that appears possible is that, though presenting a number of subtypes and a good range of individual or localized differences, yet fundamentally he belongs to but one large strain of humanity. This is the yellow-brown stem, which includes the Mongol, the Malay, the Eskimo, with a large element in the Chinese, Japanese, Tibetans and the aboriginal Siberians, and more or less of whose blood runs also in the Polynesians.

This does not mean that there have been no accessions to the American stock in pre-Columbian times. It is well known that long before Columbus some Scandinavians reached Greenland, and after that reached the "Vineland," which was probably the coast of New England. It would also be hard to believe that no isolated vessels have in the course of ages reached the continent from other parts of the world, both across the Atlantic and the Pacific. But such necessarily small parties of men, while capable, if preserved, of influencing a local culture and possibly even the language, would soon disappear through amalgamation and after a few generations would leave no substantial trace of their coming.

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Polarized Light and Plants

Preliminary Research Traces an Apparent Connection Between Moonlight and Plant Growth. More Research Is Needed. The Amateur Can Help Perform It

By Prof. H. H. Sheldon, Ph.D.

Chairman of the Department of Physics, Washington Square College, New York University

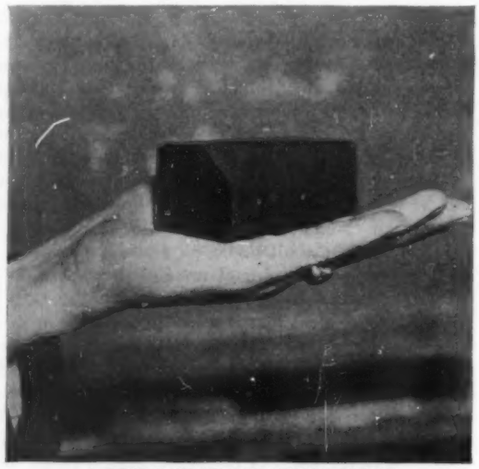
IT is seldom that so attractive a field of research for the amateur is opened up as that which has been introduced by the findings of Miss E. S. Semmens, an English botanist, on the effect of polarized light on the germination of seeds and the flowering of plants.

Informed by an old gardener that seeds sown in the full of the moon germinated more quickly than those sown in the dark of the moon, she sought to verify these results and was successful. Obviously, since sunlight is perhaps on the order of 600,000 times as intense as moonlight, there must be some other explanation of this phenomenon than the intensity factor.

On the average, moonlight is about ten percent "polarized." If this is the cause of the more rapid germination of seeds and flowering of plants, the test can be made in the laboratory, using such light. Such tests have already proved the correctness of the assumption, and this success in turn has led to many other similar tests on the behavior of sea animals, on the growth of bacteria and other related phenomena.

Before attempting to outline the procedure in our experiments, we must first have a clear idea of the nature of polarized light.

To transfer energy from one place to another through space, there are but two methods, projection and wave motion. For example, you may tear a hole in the side of a ship by sending a torpedo or shell against it; the energy is carried in the form of a material body. Or you may likewise damage the ship by creating large waves on the water. All other cases may be reduced to one of these two categories. Although contrary theories of light exist, it is simpler to think of light as being formed by waves, since the distance from the sun to us seems a long way for particles so small that they are invisible, to travel and still be able to produce phenomenon of light.



A PRISM THAT POLARIZES LIGHT

FIGURE 1: *This natural crystal of Iceland spar has been sawed in two diagonally and cemented together again with Canada balsam. In addition it has had its end faces shaved off at an angle of 68° to the side*

Such waves would not, however, be on the surface of anything; that is, they would be more like waves *in* water rather than *on* it, so that there would ordinarily be no "up-and-down-ness" to them. Instead, they would vibrate in every conceivable direction across the line of progress. A string of fuzzy Christmas-tree tinsel, held taut, might be used to illustrate this phenomenon. In the analogy, the direction of progression of the waves would be along the length of the string, while the direction of their vibration would be shown by the particles of tinsel sticking out in all directions. Now if you were to press this tinsel out flat with a flatiron, it would form an illustration of polarized light, whose vibrations are all in *one* plane. This is the kind of light we need in order to perform our experiments on plants.

Polarized light can be obtained by sending ordinary light through a Nicol prism such as that shown in Figure 1. Such a prism, if of practical size, is not only very expensive, but is also difficult to obtain, so that it is ruled out for the average amateur. The one shown in the figure is about 1½ inches across and is valued at several thousand dollars. Excellent results can, however, be obtained by reflecting ordinary light at what is known as the "polarizing angle," from a piece of plate-glass, or better still, from a pile of such plates. The polarizing angle depends on the kind of glass used, but in general, it is safe to take the angle somewhere between 55 and 57 degrees. With the arrangement shown in Figure 2, the reflected light will be largely polarized, while transmitted light will be partially polarized and can be made almost wholly so by using about ten such plates held together.

Any experiment using polarized light is valueless unless a control experiment using equal intensity of ordinary light is carried on at the same time. A second control experiment should also be carried out in total darkness, so that it can be certain that the light is really the cause of whatever effect may be observed. This necessitates either considerable precaution in arranging the lights to begin with, or the measurement and adjustment of their intensity when used.

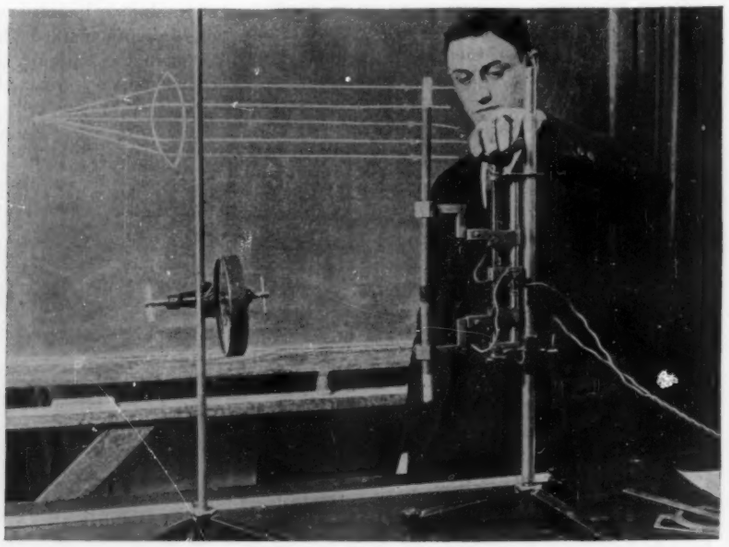
With the first idea in mind, it is best to use sunlight as the source. Arrange a pile of glass plates as shown in Figure 2a and place beside it a control pile, as shown in Figure 2b. The total thickness of glass should be the same in each case so that there will be the same absorption loss. The reflection loss at the top plate is approximately the same in each case; and although there is some polarization at the top plate of Figure 2b, it is small compared to the polarization effected by all the tilted plates in Figure 2a.

The great difficulty when employing sunlight is

All photographs made for the Scientific American by Brown Brothers

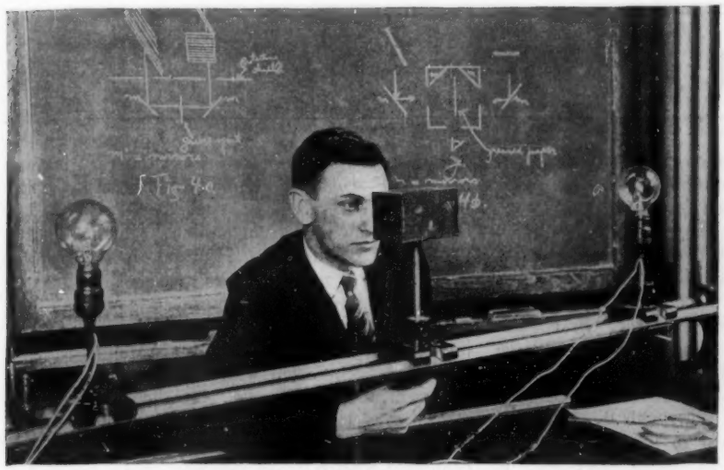
POLARIZED VERSUS UNPOLARIZED LIGHT

FIGURE 2: *The diagrams here show how illumination of approximately the same intensity may be obtained, yet the light is polarized in one case and only slightly so in the other*



PUTTING THEORY INTO PRACTICE

FIGURE 3: *The diagram illustrates the use of a large condensing lens to render rays of light parallel. The apparatus on the table shows such a system about to be put into operation*



HOW THE PHOTOMETER IS USED

FIGURE 4: *The apparatus in the foreground is a photometer in use to measure the relative intensity of the two lamps shown at either end. Almost above the box in the picture is a diagram showing the box and interior arrangement. Figure 4a shows how the box is dispensed with and a greased paper used between the sources*

A PHOTOMETER OF VARIED USES

FIGURE 5: *The instrument here shown in use is a very elaborate type of photometer called a spectro-photometer. It can be used not only to measure relative intensity of illumination but also to measure the relative intensity of each of the colors which go to make up the light from any two sources and so allow comparisons*

to keep the plates at the correct angle with the sun as it progresses from east to west. However, an ingenious person can arrange an old clockwork to do this job for him. Perhaps it is easier to use artificial light, even though this necessitates a large condensing lens to render the rays parallel in order that they may all strike the glass at the correct angle. When such rays are parallel, they should form a round spot of light about the size of the lens itself on a distant wall (Figure 3). Obviously, a large lens is necessary, but it does not have to be an expensive one. Large condensing lenses such as those used in projection lanterns can be purchased cheaply.

If it is desired to adjust the intensities of the light more accurately, this can be done very easily. Make a grease spot on a piece of white paper and reflect the light of each beam (the polarized and the unpolarized) against opposite sides of the paper by means of mirrors held midway between them (Figure 4a). If, when looking at it from the polarized side, the spot looks brighter than the rest of the paper, then the polarized light is the less intense. If the spot looks darker, the reverse is the case. The adjustment can be made by adding more glass plates or, in the case of artificial illumination, by adjusting distances from the source.

Care must be taken to prevent light from reaching the paper from any other source in the neighborhood. This may be accomplished by a screen, as shown in Figure 4a, or better still, by enclosing the paper in a box having mirrors inside to reflect a view of the paper, and holes at either side to allow the light to enter, as shown diagrammatically in Figure 4b. Such an arrangement is called a photometer.

With our apparatus arranged, we are ready to start the experiments of various sorts as best suits our own fancy.

If it is desired to test the germination of seeds, it does not matter particularly what kind of seeds are used. Such seeds as mustard, water-cress and sunflower are very useful, however, as the percentage of successful germination is rather high for all of these. For rough experiments, these can be placed in two dishes filled with soil of the same kind, or even in the two halves of the same box and separated by a card in order to keep stray light coming from one side from reaching the other. As reflected light is always more or less polarized, it is desirable to prevent it from reaching this box from any source. Consequently, such a card should be black and rough so as to give little reflection.

If really careful work is to be done, soil of any sort is not desirable, and should be replaced by a nutrient solution. A nutrient solution may be made as follows: potassium dihydrogen phosphate, KH_2PO_4, 20.4 grams; calcium nitrate, $Ca(NO_3)_2 \cdot 4H_2O$, 18.9 grams; magnesium sulphate (Epsom salts) $MgSO_4 \cdot 7H_2O$, 19.7 grams; sodium chloride (common salt) NaCl., 2 grams; ferric phosphate, $FePO_4$, 2 grams; water, H_2O, 10 liters.

Any chemist can put up this solution for you, or you can prepare it yourself. If you have no convenient way of measuring grams and liters, you can change to ounces and quarts by computing on the basis of 28.35 grams to the ounce and 1.057 quarts to the liter.

Such a solution is now to be used for soaking cotton-batting or filter paper placed in a flat, shallow dish. On this the seeds are placed. The whole may be covered with glass in order to prevent outside moisture, dust, and so on, from entering. The time required for germination can then be carefully noted, for the seeds are at all times visible. After germination has occurred, no difference in the rate of growth of the stem or leaves will be noted (according to experiments so far performed). If, however, such plants are allowed to reach the flowering stage, those in the polarized light should be favored in growth rate.

If one takes into consideration a large number of experiments which have been carried out on plants at the Boyce Thompson Institute for Plant Research, it will be seen that different kinds of plants react in a very different manner under the same artificial conditions of illumination, atmosphere, pressure, and so on. It is, therefore, obvious that one cannot at the present time predict from experiments on one plant what might take place with another.

The most recent work of Miss Semmens has been carried out on the hydrolysis of starch grains. This was done with great care. It necessitates the use of a microscope, sensitive thermocouples for intensity regulation and other expensive equipment. Thus, it is a bit beyond the means of the average amateur. In any case, this research is already being well done while the actual work of a more practical nature on plants is at present more or less neglected.

Among the other effects apparently due to the partially polarized light coming to us from the moon, may be mentioned a recent investigation by H. M. Fox (*Discovery*, London), who has shown that the sea-urchin of the Red Sea increases in size at the full of the moon, a period which coincides with its reproductive activity.

The effect of polarized light on the putrefaction of fish was first announced by E. G. Bryant, who found that pieces of fish exposed to moonlight became putrid much more rapidly than similar pieces left in the dark. More recently, G. F. Morrison has experimented on the effect of polarized light on the growth and luminescence of luminescent bacteria in fish and has reported a marked increase under polarized light.

It will be seen from this article that the field of biological research with polarized light, extending as it does from the acceleration of the flowering of beautiful plants to the putrefaction of fish, offers a wide field indeed. Further, the fact should not be overlooked that no explanation of the effects which have been observed have been given, and probably will not be until a great deal more work has been done.

Lunatics were originally so called because they had supposedly been affected by the moon. Those who thought so may not have been quite so crazy, after all.

Superstition—or Science?

Science has always scoffed at the "old wives' tale" about planting seeds by the moon's phases. Recently, however, a British scientist showed that the germination of seeds and the flowering of plants are hastened by the action of polarized light and that moonlight *is* (partly) that kind of light.

Before we fully understand these matters, more research is required. Much of it can be done at home, by the amateur scientist. It requires some seeds, a few small pieces of plate glass, some other odds and ends, and sunlight. It invades the interesting fields of physics, chemistry, biology, botany and bacteriology. In the accompanying article, Professor Sheldon tells you how to do the work.

Perhaps the old-fashioned farmer who planted his crops "in the moon" was about right. But he did not understand why. It is the discovery of this "*why*" that is the most interesting part of this or any other piece of research.

Our Point of View

"GARABED" is a new word which bids fair to enter the language. A definition of it might be "scientific hokum in support of which political pressure is brought to bear."

Perhaps you have forgotten about Garabed. Let us refresh your recollection at this time, for its originator recently has received a partial approval by Congress for a most astounding proposition.

"Garabed" is the name Garabed T. K. Giragossian, an Armenian resident of Boston, gives to his alleged "free energy generator" or illimitable source of power. Eight years ago he succeeded in having Congress pass a measure agreeing to give him extraordinary privileges if he could prove his claims.

His claim is that he has devised means to utilize energy without limit and at no cost except for the usual depreciation of machinery. He says that with his device unsinkable ships will cross the ocean in thirty hours, airships will float in the air through the neutralization of gravity, and every farmer will burn nitrates from the air with costless electricity.

The war was on eight years ago and Congress passed his measure, for "Garabed" promised to end the war promptly and forever. A commission of five scientists was appointed for a demonstration. As a result of that demonstration, the Scientific American reported as follows:

"And so, after all, it turns out to be nothing but our old friend the flywheel and its family of pulleys, that will-o'-the-wisp of the perpetual motion crank. We, ourselves, had expected that investigation would disclose an ingenious bit of mechanism, but it had not occurred to us that 'Garabed' would prove to be one of the typical perpetual motion schemes of the well-known type pursued by men who do not know the difference between power and force.

"The machine consisted of a heavy flywheel which could be set in motion by means of a system of pulleys. The flywheel was mounted in bearings in which friction was reduced to a minimum, and it was furnished with a form of electric motor driven by a small storage battery. The inventor claimed that the machine would start itself, but that it would take a very long time to run the flywheel up to full speed; and so it was started by a strong man by means of the pulleys and belts. After the machine was started, the battery was switched in and the machine would continue to rotate indefinitely.

"Apparently it took only one-twentieth of a horsepower in the electric motor to keep the machine running, and it took 10 horsepower to stop it, so that the inventor believed he was actually producing energy. Evidently he was not possessed of even an elementary knowledge of physics, such as a boy acquires in high school, or he would have realized the difference between force and power. It should be perfectly apparent to him that the energy stored up on the flywheel was that put into it by the man. All that Mr. Giragossian did after running his machine for a time was to stop it suddenly and note how great a power was developed by expending in a few seconds the energy which it had taken minutes to store up."

Now again Giragossian is demanding a patent on this ridiculous device. This time he asks more than he did before. He wants not only a patent monopoly, but to be relieved of the necessity of proving that he is the first or original discoverer.

The natural question is, why does he not apply at the Patent Office? Because he is afraid somebody will steal his invention, he says, and that it will be the beginning of long and costly lawsuits. Upon that alleged reason the Scientific American on August 31, 1918, made the following comment:

"Such an attitude should have been discouraged, but Congress by its unprecedented attentions, actually fostered these suspicions and cast a slur upon regular legal means of protecting inventors which are provided by the Patent Office. Had Mr. Giragossian applied for a patent in the usual way he would have been shown very promptly by the Patent Office the fallacy of his reasoning."

We repeat that comment now, with this addition. For Congress to lend an ear to Giragossian's fantastic scheme establishes a dangerous precedent. It opens the door to any charlatan who seeks to ignore the orderly process of government. Let Giragossian apply to the same bureau where real inventors apply and where politics will have no influence.

At Last!

Throughout the later years of arctic exploration, it has been the dream of the explorer to fly to the North Pole, and also to unlock the secrets of that vast area which lies between the Pole and the northern coasts of Alaska and Siberia. The successful accomplishment of both of these hazardous undertakings will render the year 1926 memorable forever in the annals of arctic exploration. To Lieut.-Commander R. E. Byrd, U. S. N., fell the honor of being the first man to reach the Pole by airplane, which he did in a continuous flight of 1,200 miles in an all-metal, multi-engined monoplane, starting from Spitzbergen and returning to the same base.

To that veteran explorer Amundsen, assisted by the American, Ellsworth, and the Italian, Nobile, the designer of the ship, it was given to fly in an Italian-built semi-rigid from Spitzbergen to the Pole; onward to Point Barrow on the Alaskan Coast; and thence to Teller, near Nome, in a continuous flight of 2,700 miles, lasting 71 hours, in the latter part of which he fought his way against fog, ice and blustering winds. This magnificent flight of 6,820 miles from Rome, over the Pole to Alaska, has served, as nothing else could, to restore the waning prestige of the lighter-than-air ship.

Employer, Employee, and the Public

THE outstanding lesson of the recent general strike in Great Britain was that a fight to the finish between capital and labor hurt the public more than it did the employer and the employee. For every workman concerned in the strike, there were ten citizens whose daily life was disorganized and whose very existence was threatened. Thanks to a more enlightened policy on the part of our labor leaders as compared with those of Great Britain, such a calamity as a general strike can never fall on this country. It had already been impressed upon our leaders that a strike is not merely a question between capital and labor, but between capital, labor and the public.

It is the recognition of the rights of the public, in industrial quarrels that involve the very necessities of life—coal, food and transportation—that has brought about the passage of the Watson-Parker Bill, of which we do not hesitate to affirm that, in the history of industrial relations, it is conspicuously the most notable single advance in the settlement of disputes between employers and employees. Briefly stated, the bill provides for each railroad or group of railroads, Boards of Adjustment, upon which are represented with equal power, both the management and the men. If the Local Adjustment Board is unable to settle disputed questions, the services of a prominent Mediation Board, not connected with railroad interests, consisting of five commissioners appointed by the President of the United States, may be invoked. This Board will seek to settle the dispute by the exercise of its good offices, or to bring about an agreement to arbitrate. The decision of such arbitration will be final; it will be filed with the United States District Court; and unless it were successfully impeached, it would become a judgment of the court.

Should the above methods prove ineffectual, and should it be evident that, as a consequence, a substantial interruption to interstate commerce was threatened, the President of the United States would have the right to create a Board of Investigation to report within thirty days on the facts involved in the dispute. During the Board's investigation, and for thirty days after the filing of its report, no change can be made, except by agreement of the parties to the controversy, in the conditions out of which the dispute arose.

To Teach Ship Operation

THE operation of ships, using the term in its broadest sense, has grown to be one of the most difficult and most highly specialized activities of our modern world. To build or to buy a fleet of ships is simply to stand at the threshold of a great problem containing endless ramifications. It takes highly qualified men to design a ship and to run it; but the task of developing trade for a particular line of shipping at any given port, also calls for men of very special qualifications and with a broad and intelligent understanding of the local conditions.

It was the failure to recognize these facts and act upon them, that made such a ghastly failure of the early years of the Shipping Board's operation of our newly built fleet. The story of that failure is written down in the fact that fifty million dollars had to be drawn from the United States Treasury, annually, to make good the deficit.

The recognition of these conditions has led the Massachusetts Institute of Technology to institute a new course which will prepare young men to enter the fields of shipping operation and management, and to engage in other maritime pursuits. The first and second years differ but little from the regular course in naval architecture and engineering. In the third and fourth years however, business studies in economics are introduced, and these include accounting, banking, corporation organizations, statistics, industrial relations, et cetera. Since the handling of ships cargoes is one of the largest expenses of operation and fixes the time spent in port, a study will be made of terminal facilities, methods of handling and stowing cargoes, railroad facilities and other factors involving a quick turn-around of the ship. Most heartily does the Scientific American recommend this course to those young men who wish to enter the shipping business.

Is the Earth's Diameter Changing?

By Henry Norris Russell, Ph.D.

Professor of Astronomy at Princeton University. Research Associate of the Mt. Wilson Observatory of the Carnegie Institution

THE April meetings of the various scientific societies brought out a few papers of decided astronomical interest. Probably the most important was the further account by Professor D. C. Miller of the continuation of his work with the interferometer. As, however, our readers may hope before long to have this work described by the observer himself, little need be said here, except a word of admiration for Professor Miller's spirit of scientific impartiality.

After years of most laborious and careful work, all that he asserts with assurance is that some *real* influence of some sort produces the effects which he observes. Some of the features of these phenomena look very much like the effects of "motion through the ether"—others do not, and the real nature of the influences which are at work must be left for further investigation to determine—when, if and as it can. With this conclusion the writer of these lines is in hearty agreement.

Among other matters of astronomical interest was Professor Stebbins' work on Alpha Coronae. This conspicuous star was found by him some years ago to be an eclipsing variable. Its period—known in advance through spectroscopic observations—is 17 days, 8 hours and 31 minutes. The eclipses are small—the loss of light being less than twenty percent—and, if one is observable, the next two will happen in the daytime, and the observer has to wait 52 days for another chance—probably to have bad weather. It is not surprising, therefore, that years have elapsed before a sufficient number of observations of the eclipse could be secured to provide a light-curve of high accuracy. Now that this has been done, the system turns out to be an interesting one.

The Moon's Motion Appears Erratic

The companion is much smaller than the principal star, and passes squarely across its disk. This affords an unusually good chance to find out whether this brighter star, like the sun, appears brighter in the middle of its disk than at the edge—for in such a case the loss of light will be greater when the obscuring body is in front of the bright, central region than when it is near the edge. This actually happens, so that it is clear that the star is like the sun in this respect.

Alpha Coronae, however, is a much hotter star than the sun, and gives off about sixty times as much light. If the companion was as bright as the sun, the loss of its light, when it was eclipsed in its turn, though a minute fraction of the whole, would be detectable by Stebbins' accurate measures. No such secondary minimum appears—so that the companion must be fainter than the sun. It is smaller and less massive, but according to Stebbins' calculations, it is denser. All the facts indicate that this companion is a faint dwarf star—probably red, like most of the other dwarfs. Many such stars are known, but none has previously been detected as a close companion of a bright star—for obvious reasons.

Another communication of great interest, from Professor E. W. Brown, dealt with the strange and, so far, inexplicable irregularities in the motion of the moon.

It has long been known that the observed position of the moon did not agree perfectly with the predictions of theory: but it was not until Professor Brown completed his twenty years of theoretical work, and ten years more of numerical calculations, that it became certain that, in these excessively intricate computations, nothing had been omitted, and no errors made.

There is no doubt that, after full allowance has been made for the gravitational attraction of all known bodies, the moon's motion does not agree exactly with theory. Sometimes she is five, or even ten miles ahead in her orbit, and in other years as far behind. For years together she will be ahead, then she will start, apparently rather suddenly, to lag and, after a decade or two, may have got a little behind the place calculated for an ideal moon, moving in accordance with gravitational theory.

What does this mean? Are unknown forces acting on the moon to pull her ahead or backward? Or is there some other cause for her strange behavior? The first hint of an answer is found in the fact that it is not the moon alone which behaves in this fashion. The sun, too, and Mercury, Venus and Mars, as well, all show similar irregularities, and —which is very significant—they all tend to get ahead of their calculated positions, or to fall behind them, at the same time, and the bodies which move fastest in the heavens show the greatest discordance.

Courtesy of Yerkes Observatory. Drawn by Russell W. Porter

IS THE MOON ERRATIC?

Analysis shows that it is the earth *which is erratic*

This suggests that the celestial motions may, after all, be perfectly regular, and that the trouble is with our measurement of time. If our clocks are slow, the sun and moon will seem to us to run fast and will get ahead of our reckoning, because our reckoning has fallen behind. But our clocks are continually being set right by comparison with the stars —that is, with their apparent motions across the sky, which arise from the rotation of the earth. Hence, if our reckoning runs slow, the earth itself must be slowing up; if it gets ahead, the earth must be turning faster.

The total change which is demanded is not very great, amounting to the earth's running twenty or thirty seconds fast or slow, compared with an ideally perfect clock, in an interval of several decades and therefore involving a change in the length of a single day of only one or two thousandths of a second.

But even this small change is hard to explain. We cannot account for it by any frictional action, for in this case the effect would be cumulative throughout the ages. To be sure, the ancient records of eclipses indicate that a slight retardation has actually happened, but this action is very slow, amounting to only a thousandth of a second per century in the length of the day, while the fluctuations which are now under discussion produce equally great or greater changes in a much shorter time. What is more, they sometimes slow up and sometimes speed up the rotation—and friction could never do the latter.

Professor Brown suggests, as a more reasonable hypothesis, that the diameter of the earth may be very slightly variable. If our planet should shrink, it would have to rotate faster in order to keep the momentum of rotation constant, as it must needs be, in the absence of external disturbances; if the earth should swell up, it would rotate more slowly. One percent change in diameter involves two percent change in the rate of rotation. To lengthen the day by a thousandth of a second, or about one part in 86 millions, the earth's diameter would have to increase by one part in 172 millions, or by little less than three inches. Changes a few times greater than this, with a total range of a foot or so, would account for all of the observed fluctuations.

The Earth Swells and Shrinks

In view of the geological evidence that whole mountain masses have been upheaved thousands of feet at many different epochs of the earth's history, these much smaller changes do not appear impossible. We do not know what would cause them; but we do not know what forces build mountains, either. If the hypothetical changes are deep-seated and affect the main core of the earth, it would probably be very hard to detect them by any other way than their effect in the rotation, for the resulting changes in sea level would be very small, and quite imperceptible if the expansion or contraction were uniform. If, on the contrary, the swelling and shrinking were confined to a superficial crust of a depth perhaps of fifty or a hundred miles, leaving the deeper mass unaffected, the necessary changes in diameter would be greater and would be measured in feet rather than inches. If changes were of different amounts in different continents, the changes in sea level would probably be sure of detection; but there is, of course, no reason to suppose that such changes, if they happened, would needs be both superficial and variable from place to place.

Why such changes should occur at all we have no idea; but it is of interest to note that, for a mass having the rather low thermal expansion of iron, a rise in temperature by only 1/1000 of a degree (Centigrade) would bring about an expansion of one part in 80 millions, which is of the order of magnitude which we are here considering. Whether the material of the earth's interior, which is under enormous pressure, would expand as much for a similar rise in temperature is uncertain; but there appears to be little doubt that a general change in the internal temperature of the earth by a small fraction of a degree could produce the required change in size. The heat necessary to produce even this small rise in temperature could not get into the earth's interior from without, nor escape to the surface, except with extreme slowness; but chemical or molecular changes in the material might easily liberate or absorb such amounts of heat, or indeed much more.

There seems, therefore, no reason to doubt the possibility of such changes in the size of the earth as Professor Brown suggests. The supposition that they actually happen accounts in so simple a way for the perplexing "fluctuations" in the motions of the heavenly bodies that it appears to have a great deal in its favor.

PROFESSOR COCKERELL, NATURALIST, SURROUNDED BY HIS BOOKS AND SPECIMEN COLLECTIONS

Natural History for Tourists

No Matter Where You Go You Will Find a Wealth of Subjects for an Interesting Study of Living Nature

By T. D. A. Cockerell

Naturalist, and Professor of Zoology at the University of Colorado

MANY jokes are made at the expense of the American tourist. Thus, it was alleged that an American with his two daughters called on Rudyard Kipling, and on being shown into his study said, "Are you Mr. Rudyard Kipling?" The author replied, "I am." Whereupon the father said, "Girls, this is Mr. Rudyard Kipling." Then they all marched out.

They had "done" Kipling and were ready for something else.

This does not pretend to be a true story, but it is supposed to be highly characteristic. The American is understood to be collecting impressions of persons, events and objects, and his success seems to depend on the number he can obtain in the limited time at his disposal. Thus, the globe-trotter is subject to ridicule, as an entirely superficial person who sees everything and understands nothing, and at the end of his journey, is hardly more educated than when he started. No doubt, the criticisms are often deserved, but perhaps they are based on a partially mistaken point of view.

Perhaps we should put the emphasis not so much on the rapidity and extent of travel as on the state of mind of the traveler. People spend a lifetime in a locality, and yet overlook most of the objects of beauty and interest it affords. On the other hand, to one whose mind is richly stored with knowledge, the first ten minutes before Rome or the Nile, or the shores of England, give an impression which is something to remember during the rest of life. It is much better, of course, to take more time; but with adequate preparation even the briefest stay may be made worth while.

To those fond of natural history, the briefest opportunities may give results of scientific value. I can remember many such in my own experience. Thus, in 1893, when traveling from Vera Cruz to the City of Mexico, the train stopped at a town called Soledad. Hastening across the platform, I examined a row of trees growing on the other side, and discovered the scale insect *Chrysomphalus scutiformis*, then new to science. It is now a well-known species of economic importance. In 1923, while going up the eastern coast of Siberia, I had a few moments while passengers were landed and taken on at Valentine Bay. The result was the finding of a new kind of snail, which was named *Hygromia amatoris*—in fanciful allusion to the name of the locality. In 1921, as we passed the small Cenouras Island off Porto Santo in the Madeira group, I wondered what might be found upon it. It was getting late, and I was feeling rather seasick, but in a few minutes, I had specimens of a previously unknown snail, later named *Ochthephila cenourensis*.

Adds Interest to One's Travels

To the tourist with scientific tastes, pleasure and success need not imply discovery. The old things are new to us, and no less wonderful because they have been observed before. Yet, it is a worthy ambition to wish to add something to scientific knowledge, or contribute an object of value to some great museum. It cannot be expected that the majority of tourists will become seriously interested in nature, but we venture to believe that many are capable of it; and if they do not develop their latent powers in this direction, they are losing a great deal of pleasure.

Suppose that the reader, shortly about to travel abroad, wishes to understand something of the natural history of the countries to be visited. He should take a reasonable amount of time in preparation. Securing a good map, he determines the course of his journey, and where he will probably stop. He reads certain books, readily obtainable at the public library. Having thus a background for his imagination, he looks up the histories of previous investigations and investigators, so far as circumstances permit. He soon finds that most localities or countries are classic ground to the naturalist, on account of the brilliant work of certain men. If he goes to the Hawaiian Islands, he hears of Perkins and Blackburn; if to the Madeiras, of Lowe and Wollaston. Parts of South America are still connected with the observations of Darwin; while the footprints of Wallace may be discovered, metaphorically speaking, in many islands of the Malay Archipelago.

This historical aspect should not be overlooked, for it adds human interest and quickens the desire to do something, no matter how small, worthy of remembrance. The intending traveler, now thoroughly interested, and keen to be away, has still some things to do. He goes to a large museum and looks up some of the animals belonging to the countries on his route. He may have a chance to see some of them alive in a zoological garden. Wallace, before going to the Malay Archipelago, made him-

self familiar with the birds and butterflies of that region, so far as they were represented in the British Museum. He told me that in this way he was enabled to recognize many at sight and to know when he had discovered a striking novelty.

It now becomes necessary to prepare some notes, which may be written in a little book small enough to go in the pocket. Sketches may be added to make things clearer. I always carry such a book and thus am able to recognize at once many of the things I see. During the long periods of enforced idleness on ships or trains one may take out the book and partly memorize its contents.

Possibilities of Discovery

One thing the traveler must learn is that he cannot do everything at once. It is no more possible to take note of all the animals and plants in a country than of all the people. Some form of selection is inevitable. Wallace chose to emphasize birds and butterflies; many will like to follow him in this. Others may prefer snails, or spiders, or beetles, or lizards, and nearly every one will want to know something about flowers. The marine life is full of delights, and we may choose to follow Dr. D. S. Jordan and think principally of fishes. Various considerations influence us. Thus, certain places are particularly rich in ferns, as Jamaica and Japan; Central America and Brazil are famous for their orchids; the Hawaiian Islands are the paradise of the conchologist.

If we are particularly keen about discovery, we go in for something a little out of the ordinary. Thus, in southern Peru last summer, I found many new wild bees; but had I collected butterflies, I should have found nothing undescribed.

Then again, there is the problem of securing and preserving materials. Shells are easily packed away in small boxes, such as pill-boxes. Scale insects can be put in envelopes. Beetles are easily collected in alcohol. Butterflies are harder to manage, especially when there are destructive ants which get into collections. Birds have to be shot and skinned. Mammals are even more elusive, though nocturnal species may be trapped. The practised naturalist learns how to handle whatever he is after; but the amateur may be forgiven if, since he must choose, he tends to do the easier thing. Also, he often has to consider expense and bulk, and the cost of preservatives enter into his calculations. Finally, he is likely to favor objects of beauty.

Perhaps shells form the most satisfactory collections, having all these considerations in mind. They also have the advantage of existing nearly all over the world in extraordinary variety. Land shells are usually of greater interest than those of the sea or fresh waters, because more localized and often with more beauty of color and form. If they are collected alive, the animals may be killed in boiling water and removed with a pin. In some cases, however, it is desirable to preserve the soft parts or carry home living examples, in order that the anatomy may be studied. Thus, on a small island of the Madeira group, I found the curious turreted snail *Ochthephila turricula*, which exists nowhere else in the world. I took some living specimens to England and they were the basis of a very important anatomical paper by Hugh Watson, of Cambridge.

It seems to me that one is perfectly justified in observing and forming a collection on purely aesthetic grounds. Wallace, one of the greatest of naturalists, said that he was greatly influenced by love of beauty of form and color. Indeed, the love of beauty is one of the greatest sources of happiness to ourselves and others. Another motive is to preserve objects which will recall various occasions; and if they cost effort or even involved some hardship or danger, they are all the more precious. "Trophies of the chase" need not be large and cumbersome and thus out of the question for the average person.

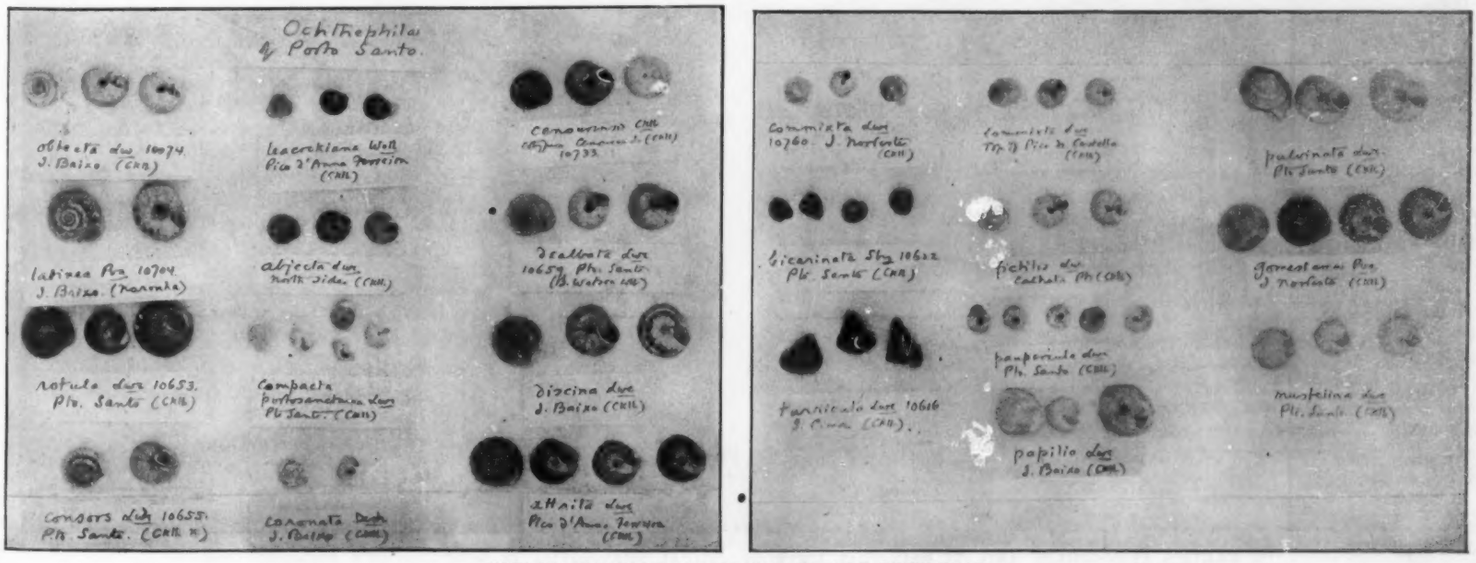
There are, however, other and more scientific aspects which need not be disdained, nor are they so technical as to be difficult of comprehension. Thus, any one may observe the life of the desert, how it is wonderfully adapted for survival under extremely arid conditions. If he is so fortunate as to visit deserts in two continents, his intellectual enjoyment may be keen. Thus, he has perhaps seen the many cacti in South America. In Africa, he sees what look like cacti, but closer inspection shows that they are cactus-like spurges or euphorbias. Thus, the lesson is learned that under similar conditions, similar adaptations arise in different groups.

A NOTEBOOK PAGE
showing sketches and notes used in the field

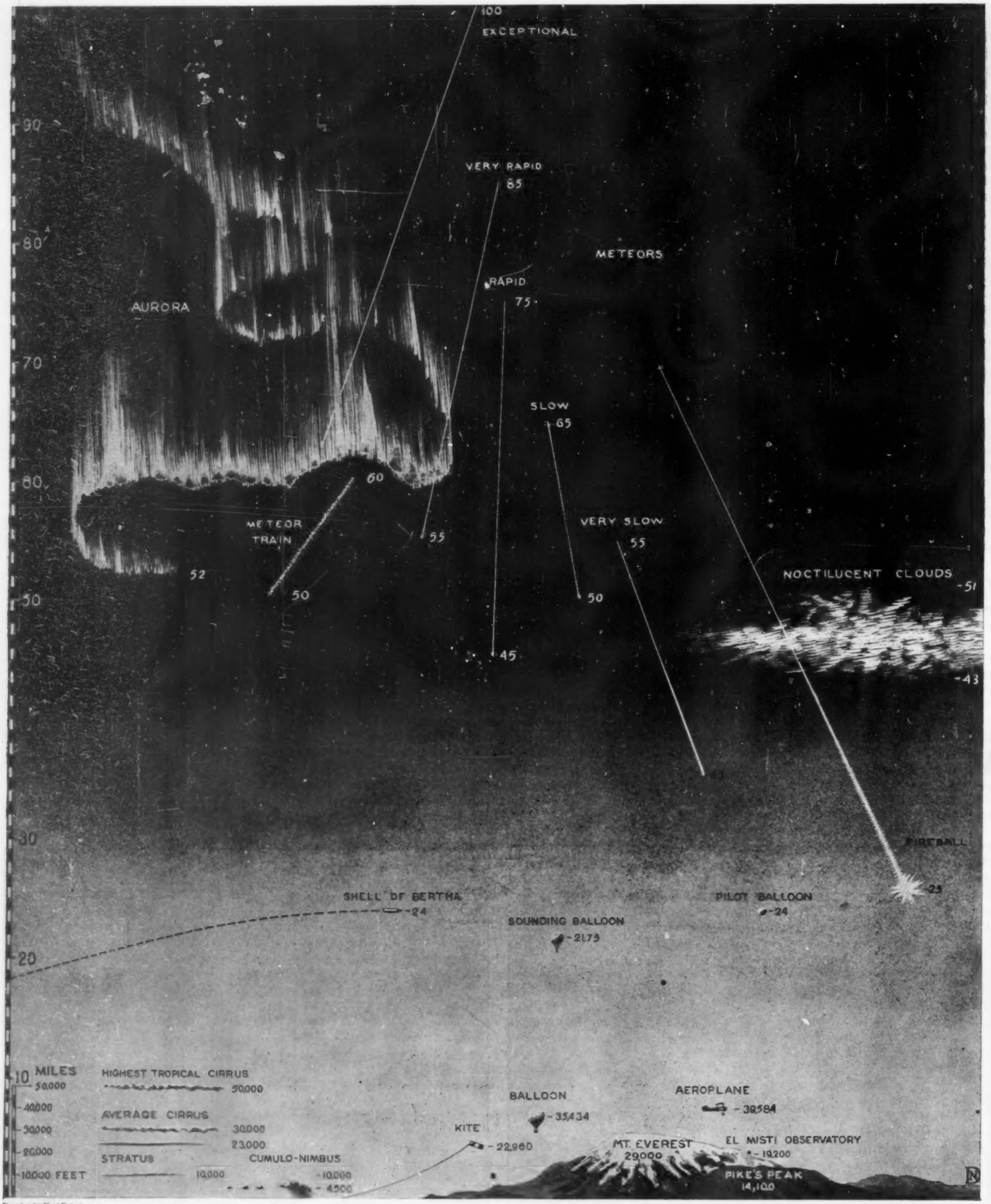
Aids Understanding of Past Events

In the moist, tropical forest, nature plays hide-and-seek, and the traveler finds endless amusement in looking for that which is concealed by color or markings. In some places, he may observe the phenomenon called "mimicry" in which certain butterflies closely resemble others which are said to be distasteful to potential enemies; or it may be moths which look just like stinging wasps. At other times the habits of animals are full of interest, whether birds, ants, or what you please. Then there is the ever-present problem of geographical distribution, dependent on present conditions and past events. How interesting to find the peacock butterfly of England on the coast of eastern Siberia, or the small copper butterfly in the Madeira Islands and in Japan. So we come to understand the vastness and unity of the Palaearctic Region, stretching across Europe and Asia from the Atlantic to the Pacific.

We need natural history guide books. At first, they would have to be subsidized; but eventually they might well pay their way. Such things do exist in Europe, and may often be purchased for a trifle in the bookstalls at the great railway stations. But the field has only been partially covered at best. Adequate guides, covering the aspects of the subject already mentioned, could not be prepared without a good deal of labor and expense, and there are not too many competent authors. Yet, the thing is possible, and it should be done. The question that now rests with you is, "When shall we begin?"



HOW TO PRESERVE SHELLS FOR FUTURE REFERENCE
These are snails from the island of Porto Santo, mounted, labeled and placed in a glass front box to be hung on a wall



Drawing by Noel Detoch

THE EARTH'S ATMOSPHERE AND ITS PRINCIPAL METEOROLOGICAL PHENOMENA, IN HUNDRED-MILE CROSS-SECTION

Height above the earth is indicated by the vertical scale on the margin. Above about forty miles, the atmosphere is extremely thin. The white lines represent meteor trails

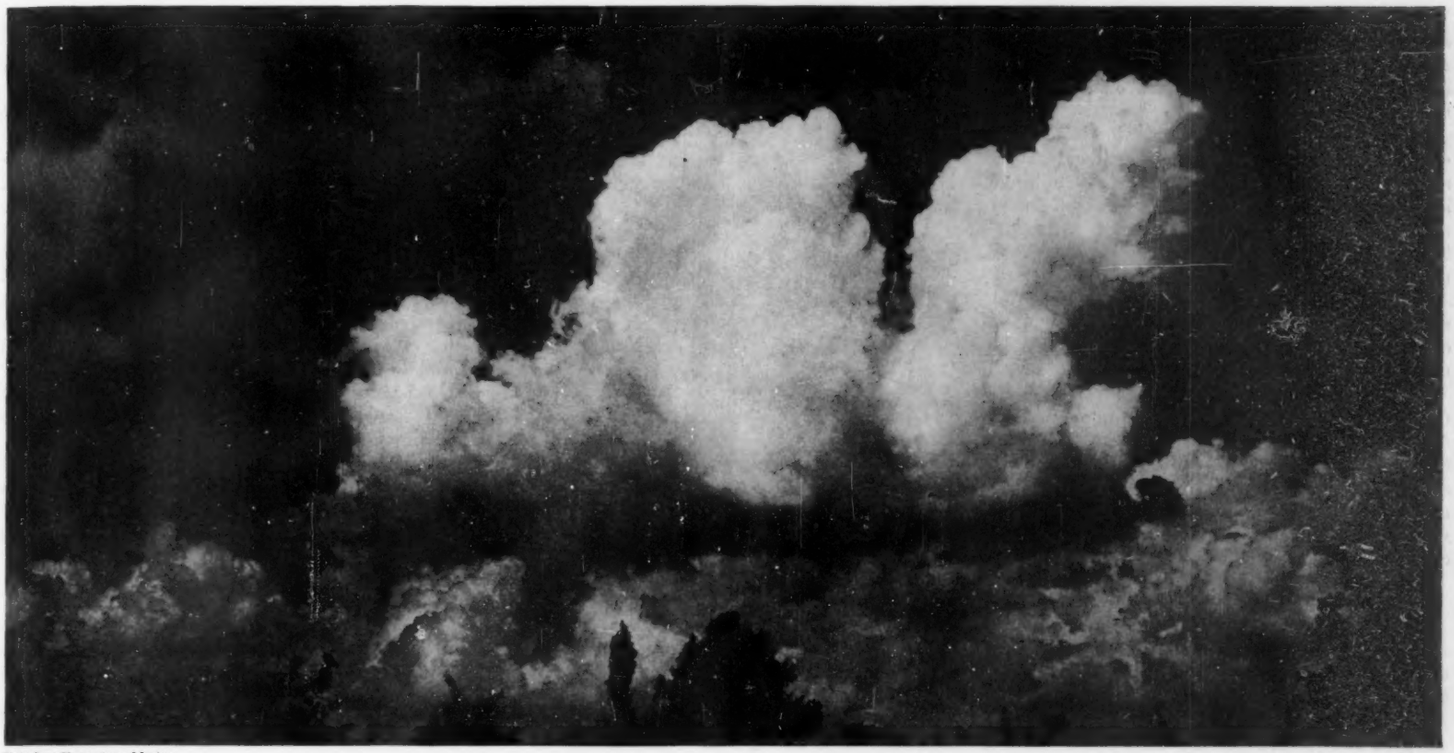


Photo from Observatory of Juvisy

CUMULUS MAY REACH A HEIGHT OF 10,000 FEET. AN UPRUSH OF AIR HAS CAUSED THIS FORMATION

How High Up?

Far Above the Clouds and Extending Out Towards Empty Space There Are Many Interesting but Incompletely Understood Phenomena. Can Science Explore These Lofty Regions?

By Noel Deisch

ALTHOUGH meteorological science is ready with an abundance of good data bearing on the phenomena of the atmosphere, it is anything but forward in assigning a definite upper limit to this great ocean that surges above us. There appears to be a rather abrupt thinning out at a level of about 50 miles, but reliable evidence points to the existence of an exceedingly tenuous mantle of gas reaching far out beyond this, until finally it appears to merge imperceptibly into the void of interplanetary space.

If one could climb to the summit of Mt. Everest he might look down, at the comparatively low elevation of 29,000 feet, or about five miles and a half, on practically all of the clouds. In fact the cumulus clouds, most familiar of all types, would lie well over four miles below him, for they usually float at an altitude of only about 4,500 to 6,000 feet above the earth's surface.

Atmosphere Far Beyond Zone of Twilight

The nimbus or storm clouds, which are often a development of the cumulus, may at times rise to a height of 10,000 feet, with the base still resting at a level of 4,500 feet. Stratus clouds may occur at a height of anywhere from 10,000 to 23,000 feet, whereas the most elevated of all clouds, the fleecy cirrus, are situated at an altitude of about 30,000 feet, or occasionally as high as 36,000 feet.

Clouds in the tropics occur uniformly at a greater height than in the temperate zone, and here the cirrus may at times be seen at a height of about 50,000 feet, or over nine miles.

There is another rare form of cloud which looks a good deal like a cirro-stratus, but is not to be classed with the ordinary water-vapor clouds at all. in fact it is regarded as consisting of a suspension of very fine particles of dust which have been projected to a great height during the course of a violent volcanic outburst. This is the noctilucent cloud. These clouds exist at very much greater altitudes than any of the ordinary water-vapor clouds, and due to this fact they have the peculiarity of being luminous in the dusk long after the sun has set, a characteristic that has given them their name.

DR. ROBERT H. GODDARD
who has made valuable researches in the upper air

Such clouds, produced by the explosive eruption of Krakatoa in 1883, were found on measurement to lie at the surprising height of from 43 to 51 miles. This is the record for phenomena seen in the atmosphere by the light of the sun. The limit of the zone of twilight, beyond which the stars are visible, even in daylight, is also located just about at this level.

The meteors and the aurora, however, give spectacular evidence that the atmosphere exists far beyond the zone of twilight. Their height has been calculated with very good accuracy, the data for the trigonometrical computations being secured by a pair of observers working at stations situated at a good distance from each other—say from 10 to 50 miles or more. Meteors are generally observed visually, their tracks being plotted on a star-map, but in the case of the aurora, photographic methods are given preference over naked-eye observations.

A Streamer 375 Miles Up

It has been ascertained in this manner that the very rapid meteors usually flash a light at a height of from 75 to 85 miles and become extinct at a height of from 45 to 55 miles. The slower meteors become incandescent at a height of from 55 to 65 miles and descend to within 50 to 25 miles of the earth's surface, and on rare occasions a large one may fall right on through to solid earth.

Meteors are not often seen at heights above 80 miles, and quite rarely above 100 miles, although apparently reliable observations have on a very few occasions indicated considerably greater heights.

Very small meteors, visible only in telescopes, occur at heights computed to be from 1,000 to 4,000 miles above the earth, but these results are based on scientific inference rather than on unassailable data.

It is interesting to note that the luminous trails occasionally produced by meteors occur only in the stratum lying between about 50 and 60 miles of height, the average being about 54 miles, even though the meteor by which the train was produced may have been incandescent on either or both sides of this stratum.

Careful measurements of the height of the aurora show that the greater number of these occur at an elevation of between 53 and 200 miles, there being maxima at 62 and 66 miles.

The arched form of aurora occasionally reaches up as high as 300 miles into the air. In one case the Norwegian observer Störmer, who has recently obtained some very accurate results, photographed one such streamer situated at a height of 375 miles. This represents the record height for any phenomenon which can properly be conceived as occurring in the earth's atmosphere.

Man Has Exceeded 28,400 Feet

The meteors and the aurora are the only witnesses which give testimony concerning the constitution of the higher regions of the atmosphere. The deeper layers of the atmosphere, on the other hand, are subject to direct study, either by direct visual observation or through the intermediary of instruments. Some permanent weather observatories are located at very high elevations on mountains, such as the observatory on El Misti, Peru, at a height of about three and one-half miles. Observations have also been made by special expeditions to high altitudes.

The best that has ever been done by mountain climbers exceeds 28,400 feet, that being the elevation at which George H. Leigh-Mallory and Andrew Irvine, of the British expedition into the Himalayas, were last seen, still climbing towards the summit of Mt. Everest, on June 8, 1924.

Balloons, which have the advantage of making but little active demand on the physical capacity of the observer, were formerly very extensively used in the investigation of the atmosphere. Coxwell and Glaisher as early as 1862 reached an observed height of 29,000 feet, and rose beyond this to an estimated height of 37,000 feet, but the credit of having reached the greatest reliably observed height in a balloon is commonly accorded to the German meteorologists Berson and Süring, who on July 31, 1901, reached an altitude of 35,434 feet.

ROCKET FOR TESTS IN VACUO
One of Dr. Goddard's experimental devices

To the aeroplane, however, must be accorded the distinction of having lifted a human being to the highest point above the earth that he has as yet been able to attain, the record of 39,586 feet having been set by the French aviator Callizo in October, 1924. The difficulties of ascent at these altitudes, both as respects the machine and the pilot, are enormous. Much below this level the atmosphere is inadequate of itself for the support of life, and recourse must be had to oxygen for breathing.

Indeed, calculation shows that the present world's record lies very near the limit of attainable height even when pure oxygen is used, and it appears that if much greater heights are to be achieved measures will have to be taken to enclose the aviator in some kind of pressure-suit, or in a hermetic chamber, which will allow the pressure of the contained gas to be held at a higher value than that which prevails in the surrounding medium.

So far as the mere purposes of meteorology are concerned, wholly satisfactory results can be had by sending instruments aloft unattended by an observer. For a long time kites were used to a large extent for this purpose, the record altitude being 22,960 feet, attained in a kite ascent from the Mount Weather Observatory in 1908.

Sounding balloons made of very thin sheet rubber of the best quality and so constructed as to release the instruments which they carry—themselves marvels of lightness—at the highest point of their travel, so that they may settle to the earth in a parachute, have also been much used for this purpose. Such a balloon liberated by the German meteorological service reached the surprising height of nearly 22 miles. Pilot balloons, which do not carry any apparatus but are used merely to determine the direction of air currents, have been followed with the theodolite as high as 24 miles.

Projectiles have gone yet higher, and their flight represents man's most ambitious achievement in his effort to escape the bonds that bind him to the earth. It has been computed by artillerists that the shell of the "Bertha" that bombarded Paris rose to a height of 24 miles at the apex of its trajectory, and of course it would have gone very much higher had the gun been aimed vertically.

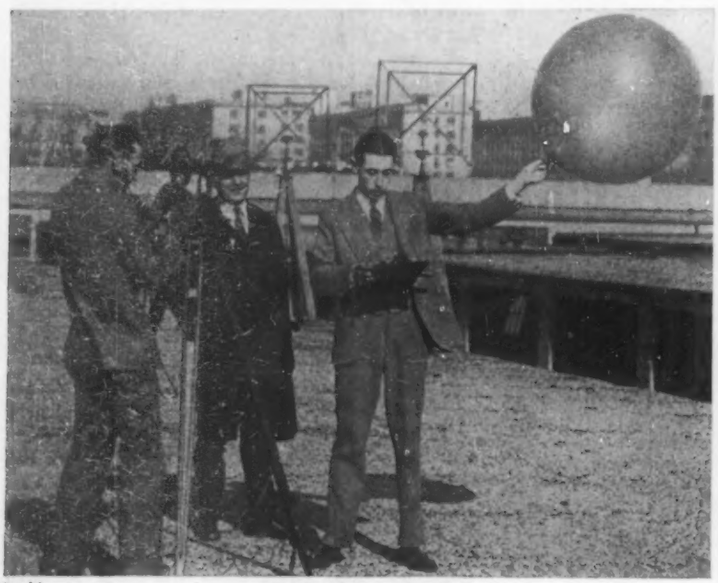
Can We Reach Higher Levels?

No attempt has been made to date, however, to utilize the ascent of shells for the purposes of meteorological research, although such suggestions have been advanced.

The fact that a modern high-velocity gun could throw a shell well above the zone of twilight into a region about which there is a great deal of scientific curiosity, makes these suggestions very interesting.

Dr. Goddard, as is quite well known, has thought to apply the rocket in this work, and has done a great amount of scientific research in an effort to put the project on a sound physical basis, the results being of a character to give great hope of this device being developed to a point where it will allow of instruments—gas-collecting apparatus, and the like—being sent to the very highest levels of the atmosphere, and indeed even into the empty region beyond.

The development of some method of this kind is of the first importance for the investigation of the vast region that lies beyond the highest ascents of sounding-balloons, a region concerning whose composition, temperature, electrical state, and so on, at various heights there is very little accurate knowledge and a vast amount of contradictory conjecture.



P. and A.

SOUNDING BALLOON
This type of balloon is used for determining air-speed conditions

AURORA BOREALIS
This phenomenon occurs at heights ranging from 53 to 375 miles

From photographs specially made for the Scientific American under the direction of William F. Mangels

Miniature Amusement Devices for the Tiny Tots

In the larger contrivances designed for thrills and amusement, the speed is so great that the children have to be tied in and there is anxiety until the little ones are restored to their parents. Many of the so-called "rides" are now made in miniature so that the child's joy need not be mixed with fear. In the upper left-hand illustration we show the well-known "whip" car with a small edition of the same beside it. At the upper right a whole installation of the whip laid out for children is shown. "Ferris" wheels do not present much danger, but wire-screened cars (as shown in the center illustration) at least look safer than an earlier model shown to the left of this. At the lower left is shown a medium-sized merry-go-round. In the miniature roller coaster, shown at the lower right, the humps and bumps are gentle. Directly above this, a merry-go-round for very small patrons is shown.

DR. PRINCE, NOTED PSYCHIC INVESTIGATOR, IN HIS STUDY

Before him are four of the five printed "Patience Worth" books, also 15 volumes of typed records. The loose sheets are the results of his personal studies while in St. Louis

The Riddle of Patience Worth

Here Are Presented the Records, to Date, of an Investigation Conducted in a Scientific Manner by a Serious-minded Seeker After the Truth

By Walter Franklin Prince, Ph.D.

Research Officer, Boston Society for Psychic Research

IN August, 1912, Mrs. Emily Hutchings and Mrs. Pearl Lenore Curran of St. Louis began to dabble with the ouija board, the latter, at least, in no spirit of seriousness or belief. Commonplace stuff resulted, in part banal "messages" claiming to be from dead relatives and friends. It was not deemed worth while to make any record. But at two consecutive sittings material of a markedly literary character was received and at the next, July 8, 1913, came this:

"Many moons ago I lived. Again I come—Patience Worth my name. [Interruption by surprised sitters.] "Wait, I would speak with thee. If thou shalt live, then so shall I. I make my bread by thy hearth. Good friends, let us be merrie. The time for work is past. Let the tabby drowse and blink her wisdom to the fire log."

A few sentences followed this quaint and striking paragraph, and some one ventured a joke at the expense of the purported communicator, who retorted:

"Wilt thou but stay thy tung [archaic spelling characteristic of a part of Patience Worth's output]! On rock-ribbed walls beat wisdom's waves. Why speak for me? My tung was loosed when thine was yet to be."

Thus emerged from somewhere the genius of "Patience Worth," full-orbed, like Aphrodite from the sea. Since then a stream of poetry, fiction and table-talk has been pouring forth, embodying extraordinary mastery and variety of literary expression, spirituality, wisdom, knowledge and wit. Never inferior, often the literature rises to a very high level of beauty. There is a facility in the employment of brilliant metaphor which seems to me hardly surpassed.

At first, all was spelled out on the ouija board. Then the letters began to come in the mind of Mrs. Curran (who proved to be the psychic in the case), and the pointer simply swept around the board as a vestigial automatism. Then the board was discarded and the psychic spelled so rapidly, with no pauses between the words, that only an experienced recorder could follow the delivery. At last came the stage of receiving by words, uttered at a speed limited only by the capability of the scribe, who, for the sake of accuracy, can use shorthand only in part, because of the peculiarities of the diction. Mrs. Curran is quite conscious at the time, and can at any moment break off to converse or answer the telephone, resuming where the dictation stopped.

"Patience" Shows Unusual Versatility

A novel of the time of Christ, "A Sorry Tale," of 325,000 words, was composed, spelled out letter by letter, before witnesses. It was published by Henry Holt and Company, and has been pronounced one of the finest attempts to portray that period. An idyll called "Telka" and laid in the Seventeenth Century, to be published soon is, in the judgment of some literary experts who have read it, a masterpiece. When I had gone about two-thirds of the way through it I felt sure that it had reached a climax from which it must fall off disappointingly; but the last fifteen pages or so proved to be of such poignant beauty that I walked the floor repeatedly before I could command myself sufficiently to go on —a rare experience.

"Telka" is said to contain the largest percentage of words of Anglo-Saxon origin in any known book since Wyclif's Bible. "Hope Trueblood," also issued by Holt, is a story in modern English laid in mid-Victorian England. Some British reviewers disparaged it and some highly lauded it; but only one (who may have heard a rumor about "Patience Worth") suggested that it might not have been written by an Englishwoman. One of the hardest literary feats is to get the proper local color and stamp of local language. Yet not a British critic found flaws in respect to these—and Mrs. Curran had never been outside the Mississippi valley. Three other books of poetry and prose have been printed. There is little doubt that had it not been for the ouija board "fly in the amber," the Patience Worth literature would have won a wider recognition than it yet has done. But it undoubtedly appeals more to highly intelligent and fastidious minds than to the masses that eagerly read and speedily forgot the clever jingles of Will Carleton and Ella Wheeler Wilcox.

One of the astonishing features of the case is that an auditor may select a subject for a poem and, no matter how unusual the subject is, within a few seconds the poem begins. It proceeds with all the usual rapidity, pauses being made only to allow the recorder to catch up, with never a correction. I was present at a meeting of the Artist's Guild of St. Louis where more than twenty short poems were

dictated on subjects given at the moment. The poetry is sometimes in rhyme, but usually is in rhythmic free verse of iambic meter. I can present but a few briefer bits so composed. Let it be understood that the delivery, in every case, began almost instantly after the subject was given.

Discouragement

"To acknowledge defeat?
When God hath flung the sun
From His open hand,
Lifted the curtain of the day,
And said: 'Behold, my child, behold?'"

A Field of Daffodils

"x x x the great God
In a sudden mercy, bent
And kissed the field,
And lo! the soil was pregnant
And gave forth a golden smile."

Pompeii

"Like a jewel of pearls about the hillock's throat,
The proud, proud hillock, with her head of fire;
Like a necklet of pearls about her false, false throat—
An instant, and behold!
The labor of time becometh naught
But ash and smouldering ember."

Keats's words (misquoted by proponent) "Magic casements opening upon fairy fields forlorn"

"I see fair fields where tufted poppies flaunt
And grain sags heavy 'pon its stem,
Where larks nest in the shadowed coves
At roots where damp still clings.
Cool, restful cool, and quiet is the spot,
And riotous poppies fringed about the nest
Bleed in their joy.

I see the hillocks, wrapped in purple shadows
Veilèd of mist, watched by sentinels—
The pale, pale stars,
Or guarded by the jeweled moon.
I see a river winding hence,
Plunging seaward in exulting joy.

I see cool pools sunk deep within the shadowed spots,
In some far forest glades,
Molten of sunlight and of shadow,
Woven of mysteries reflected from the sky—
A vagrant cloud, a half-hid star,
Some fright-winged bird, inscribed.

I see a fair, fair land a little way beyond—
A magic land; and I would dream
Behind the casement—fancy.
Yea, I would retreat, letting my soul
Go roving, while I watch and sing."

MRS. PEARL LENORE CURRAN
at eighteen years of age, with father and dog

Thought-Compelling Psychic Phenomena

Amazing as are the annals of the psychic world, we doubt whether a more thought-compelling account of a psychic event than that which appears on these pages has ever been published. A woman of plain, simple antecedents suddenly develops the ability to phrase prose or poetry of recognized worth, either in the language of old England or in that of other periods, and to do so on such instant call, and with a display of linguistic and topical knowledge far exceeding that which scholars familiar with the case can so far explain on the basis of her experience. True, similar demonstrations under certain conditions have been "faked," and it will be noted that the well-known author of this account makes no final claims for its genuineness. He simply states the case, adds a few observations concerning it, and leaves the problem open.

Those who have read Dr. Prince's previous articles in the Scientific American, and those who know of his life-long investigations in the field of psychical research, will doubtless agree with us that he is actuated by truly scientific motives, not deliberately setting out to establish the genuineness of a given psychic phenomenon, but, if possible, to ascertain the truth.—EDITOR.

To the subject "*Flappers*," she instantly and laconically responded, "They dare what the past hoped for"; and in response to "*The Press*," she contented herself by cynically ejaculating, "The gab wench of the day."

Here are a few of the aphorisms of "Patience Worth," flung off like sparks in conversation. "Beat the hound and lose the hare," "A basting but toughens an old goose," "To catch a flea needs be a dog?" "Prod ye the donkey's rump, ye are sure of a kick," "The jackass deemeth the thrush hath stolen of his song," "The piggie that scratcheth upon an oak doth deem his fleas the falling acorns' cause," "Thy abode is *within*."

There is a quickness and aptness of witty retort such as I have never known equalled. When some one wished that she might know of the after life, "Patience" flashed out, "Ask the cat—she dieth full oft"; and a discontented woman who expressed vain wishes was told, "From constant wishing the moon may tip for thee." To one who objected that a certain expression is known in connection with a personage of the Nineteenth Century whereas Patience claims to have lived in the Seventeenth, she retorted, "Dost thou flatter thyself that today's thoughts and deeds were born today, by such a fledgling as thou?"

Often persons get responses to subjects suggested by them which seem to show uncanny knowledge of their unexpressed thoughts. One of my several experiences of this kind is as follows: In my house is a cocker spaniel whose love and devotion are so extraordinary, even for a dog, that I have sometimes remarked, "It is awe-inspiring! It is cosmic! It seems as though I were realizing a force in the universe expressing itself in that dog." But nothing of the kind did I say in St. Louis when I gave the subject, "A Cocker Spaniel." This is what Patience said:

"Is it God within those deep, deep eyes?
Could love express from human kind
More than the tremble of thy flesh,
The eagerness of thy desire,
The leap of thy service?
Once I have known thee have I not known God—
Have I not found Him in a newer way expressed?
Companion, making one with my day;
A fellow, mute yet eloquent!
Can I forget thou art the game at my hand
And the servant at my feet?"

Besides being a terse description of the dog, this beautiful verse expresses the thought in my mind when I named the subject.

What Is the Answer?

The Patience Worth literature, as produced through the mouth of Mrs. Curran, presents several weighty problems.

I. The problem of literary genius. By all the testimony yet gathered, that of Mrs. Curran and of others who knew her at different periods, she had never shown, before the advent of "Patience Worth," literary talent, never practiced to attain it and never aspired in that direction. Like a large percentage of girls, at the romantic age she perpetrated two or three sets of rhymes. I saw one of them in the original manuscript. It was mere doggerel. More than that, she had read little, not at all discriminatingly, and had no particular taste for poetry.

II. The problem of knowledge. It is declared that her school education ended at fourteen, short of the high school, except for music, which she cultivated and in which her ambition centered. It seems to be established that she has very little normal knowledge of history or foreign lands and that she never made a study of words. Yet Patience seems

MRS. CURRAN TODAY
Showing her at the time of the writing of this article

to have not inerrant but a great deal of knowledge regarding the past and other countries. She also uses correctly many archaic words and forms others from Anglo-Saxon roots.

III. The problem of wisdom. Mrs. Curran is a bright and sensible woman; but never, according to testimony, did she manifest in her speech anything to approach the profound sagacity and the lofty spirituality which now pours automatically from her lips.

IV. The problem of seeming divination of what is in human minds. Certainly Mrs. Curran had not appeared to have that mysterious faculty.

So impossible did it appear normally to account for this product on the basis of Mrs. Curran herself, that at one stage there was a theory that some literary genius and scholar composed what she memorized and recited. But instant composition on suggested subjects killed that theory.

Then it was suggested that she got the literature by telepathy from the intellectual group gathered around her. But it gathered around her because Patience had already dictated. The group varied, and at times was not intellectual; but Patience continued unaltered.

One psychologist, whose theories are confirmed and inflexible, wanted to hypnotize her, feeling sure that thus the story of her life would furnish an explanation. But he would poke her with his finger, asking, "Do you feel that?"; and, since she is without hysterical stigmata, it produced an unpleasant impression and she declined to be hypnotized. I should not have advised otherwise in this case; for, while facts can be drawn out by hypnotism, a violently prejudiced person can also interject them. The elicited story might have been as much the result of his suggestions as is the belief of a hypnotized subject that an onion is an apple.

Another psychologist has written a long article about her. He exonerates her from having any conscious education, in or out of school, to fit her for the literature. He exonerates her reading entirely. He credits that she had never associated habitually with historians or philologists, and believes her when she says that she had no memory of ever hearing any such scholars talk. But he thinks that below the threshold of her consciousness is a secondary personality which has subconsciously listened to information of which she was consciously entirely unaware. But this would require that she did not hear only a few times subconsciously, for instance, philologists using archaic words and *defining* them, but there must have been a vast deal of this going on; and yet she has no remembrance of ever being in the company of persons holding such discourse a single time. Not only this, but we may search the records of split consciousness in vain to find a secondary personality which suddenly manifested talent amounting to genius in a field wherein the normal consciousness had never shown any noticeable talent, had any practice nor cherished any such ambitions.

The Folly of Atheism

[She] Hae ye seen the mummers settin up a puppet show, athin the fielding?

[He] Nae.

Who doubts his God is but a lout;
Who piths his wisdom with egotry
Hath lost his mark.

[She] Aye. I see'd 'em fetchin past, and brayed o'er wi' a ribbon and a new latchet, and a shoon bucklin and tasseled thongs.

To doubt is but to cast thee as a stone
Unto the very heart of God.

[He] Aye, and I fetched me a whistle; and heered the doings of the village — that Mark, o' the smithy, haed a new wench; and she be heft.

[She] Aye, a wide tale. I heered it, but heeded it nae, I bein' feastin 'pon the new thong.

Who doubts his God
Hath but announced his own weak limitation;
Hath tied his hand and fettered of his foot.

[He] Weel, 'gad! Did ye see the dominie wi' his new breeks, and a sabba' shirt?
Weel, can ye heed it, and him at the Fair?
A wide tale, eh?

To doubt thy God
Is but to stop the everlasting flow of mercy;
To die of thirst and lose thee in the chaos of thyself.

Here is the puzzle of Patience Worth, and I present the case at this time only as such. I want to rake Mrs. Curran's past with a fine-tooth comb, and she is willing that it shall be done. If any person living is in the possession of knowledge about her which will or may present any clue, I shall be grateful to receive it; and I request all readers who knew her before 1913 to write to me and tell what they know.

Psychologically or psychically, the case is the most amazing one of its kind in history. It was possible to give here only a glimpse of its magnitude. The few brief passages have been taken almost at random. I have as yet only nibbled at the fifteen volumes of records now in my possession, in addition to the printed works, altogether containing three million words.

Were there space it would be interesting to learn the results of some of the unusual tests which I devised. A poem of twenty-five lines was demanded, the lines beginning with the letters of the alphabet, except X, in due order. It was instantly dictated. I asked for a conversation between a lout and a maid at a country fair, to be couched in archaic prose, and a poem in modern English on "The Folly of Atheism"—first a passage of one and then a passage of the other, thus alternating to the end. This seemed to me an impossible mental feat. But it was done so rapidly as to tax the recorder—four passages of humorous prose abounding in archaic locutions, alternating with four parts of a poem in modern English of lofty and spiritual tenor; and when assembled each factor made a perfectly articulated little piece of literature.

"Patience Worth" treats doubts regarding her being with humorous forbearance. To her name given as a subject, she responded:

> "A phantom? Weel enough,
> Prove *thyself* to *me*.
> I say, behold, here *I* be,
> Buskins, kirtle, cap and pettiskirts,
> And much tongue!
> Weel, what has thou to prove *thee?*"

What wonders there are to be found in the depths of the sea! What beautiful masses of coral and schools of fish! These were studied by means of the Williamson under-sea tube. A description of this work by Roy Waldo Miner will be found in our August issue.

MRS. CURRAN'S EARLY HOME
located in the quiet secluded town of Palmer, Missouri

MRS. CURRAN'S PRESENT HOME
in St. Louis, Missouri, is shown at the right of the illustration

Science Invades the Farm

It Is a Far Cry from the Man Behind the Plow to the Modern "Once-over" Tiller Drawn by a Gasoline or Steam Propelled Tractor

By Archer P. Whallon

ONCE there was a lazy country boy (he now is a writer for scientific magazines) who had a big imagination. He pictured the day when a farmer would press a few electric buttons and all the work of caring for the old 180-acre farm—the plowing, the harrowing, the seeding, the cultivating, the reaping, the binding, and all the rest of it—would be done automatically.

A wild idea, they told him when he spoke of it at the supper table. But thirty years have rolled by since then, and it begins to look as though the boy's picture of the future might become a reality after all. At any rate, a long step forward has been taken. Today the up-to-date farmer has at his command a wealth of labor-saving devices.

More Play Less Work

A new day has dawned on the farm—a day in which the farmer need not grow old before his time, a day in which he can work less and play more than did his father and yet make the old place pay as his father never was able to do.

And this new day has been ushered in by a flood of time-saving and labor-saving inventions.

The current of farm machine invention flows in three parallel streams of activity; the development of larger sized and more efficient implements and equipment used in the prevailing farming practice; the invention of new types of machines that eliminate some of the tasks that have hitherto been necessary in the sequence of crop production; and the invention of other new machines that apply mechanical methods to farming jobs that were otherwise tasks of labor and time-consuming drudgery.

The multiplication of the working capacity of the farmer through an increase in the size of implements is well exemplified by the contrast between

THE OLD WAY

Tedious hand work is giving way to farm machinery. Result: Greater profit from the land

the man working with a two-horse, six-foot smoothing harrow, plodding along in the dirt, and the tractor which pulls over one hundred feet of the same implement—a contrast about as striking as that between the first-named outfit and the drudging Oriental equipped with a hand rake.

But American farming efficiency is advanced not only by increasing the size of implements, but also through the development of more economical power plants. A notable example of this development is shown in the appearance of two steam farm tractors which unite features (steam condensers and automatic fuel regulation) that give them the convenience and versatility of the gas-engine tractor, while retaining the well recognized merits of reliability, economy, and durability of the old-time steam traction engine. Both are twenty-horsepower engines, the one an oil-fuel machine, the other having a coal-burning boiler.

Perfect Seed Bed in One Operation

Innovations that revolutionize farming methods by combining in one operation—a single passage over the field—work that must otherwise require several successive operations, are obviously of the greatest economic value. Here, in the initial tasks of plowing and soil fitting a relatively new implement enters—the universal or "once-over" tiller. It combines the advantages of the common moldboard plow and those of the complicated power-driven rotary tillers of Europe. This machine, furnished for attachment to the ubiquitous small tractor, consists of a plow

bottom fitted with a power-driven bladed or toothed rotating member that catches the furrow slice as it turns from the plow and, thoroughly pulverizing it, forms a perfect seed bed at the single passage over the field.

Originally, in its practical realization the product of the Pacific coast, the combined harvester-thresher has now found its place and is revolutionizing grain production throughout the world. There are now around 4,000 small-type, combined harvesters in Kansas; and an invasion of the harvest fields of Illinois and Indiana has taken place.

Mechanical Maturing Possible

These small "combines" have their mechanism driven by an attached motor, and, with headers from 9 to 18 feet wide, may be drawn by light tractors (the 9-foot by the Fordson) or by from 8 to 20 horses. The grain may be sacked, or in the bulk-grain method, delivered to an accompanying wagon or carried in a tank mounted on the harvester and later disposed of as desired.

Ordinarily, the straw leaves the harvester in a windrow; but straw-spreading attachments are furnished. Other attachments for leaving the straw in piles convenient for haulage are also furnished. Further, there is equipment for the stationary threshing of bundled grain (self-feeders and straw stackers) and for harvesting and threshing kaffir corn and the other grain sorghums.

Bean and pea harvesting equipment is also made, and some makes can be fitted for harvesting sweet clover and soy beans. Several companies make hill-side models that can be operated on 50 percent grades. With most designs the header is detachable and may be mounted on a transport truck and trailed at the rear of the thresher. This is for convenience in passing along roads, as well as for allowing the machine to be taken through narrow gates and over bridges.

Brown Brothers

FOLLOWING THE HORSES

This slow harrowing process is now combined with plowing by machinery

The advantage of the "combine" in labor-saving over all other harvesting methods is obvious and incontestable. One trip over the field and the job is done! There is no delay during which the crop may be damaged. On the contrary, the grain is in the sack and the field cleared ready to be fitted for another crop—and the farmer has no binder twine or threshing bill to meet. Two or three men do the work of the dozen that are required by the binder or header and by stationary thresher methods. It is even possible, under favorable conditions, for one man to do the whole job.

In monetary terms this works out—for wheat harvesting—to be a reduction in cost from $0.226 per bushel required by the binder and stationary thresher method, to only $0.034 for the "combine."

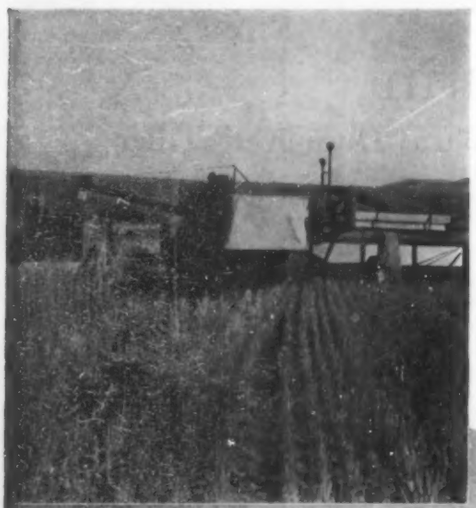
In Kansas, Nebraska, Colorado, Oklahoma, and Texas there are about 161,000 square miles of land, with an approximate production of 150,000,000 bushels, that may be conservatively regarded as "combining" territory. This does not make any claim for extensions due to possible further adaptive modifications of the machines.

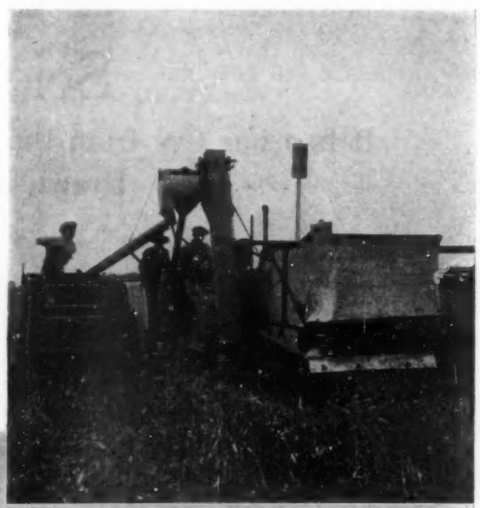
It has long been the prevailing opinion that grain must attain a condition of uniform maturity in order that it may be successfully handled by simultaneous cutting and threshing, a condition only met by a tranquil and somewhat arid climate. More recent experience seems to show that the necessity of this condition has been overestimated; and there appears the further possibility of extending the field of service of the combined harvester through artificial or mechanical curing or drying of the threshed grain.

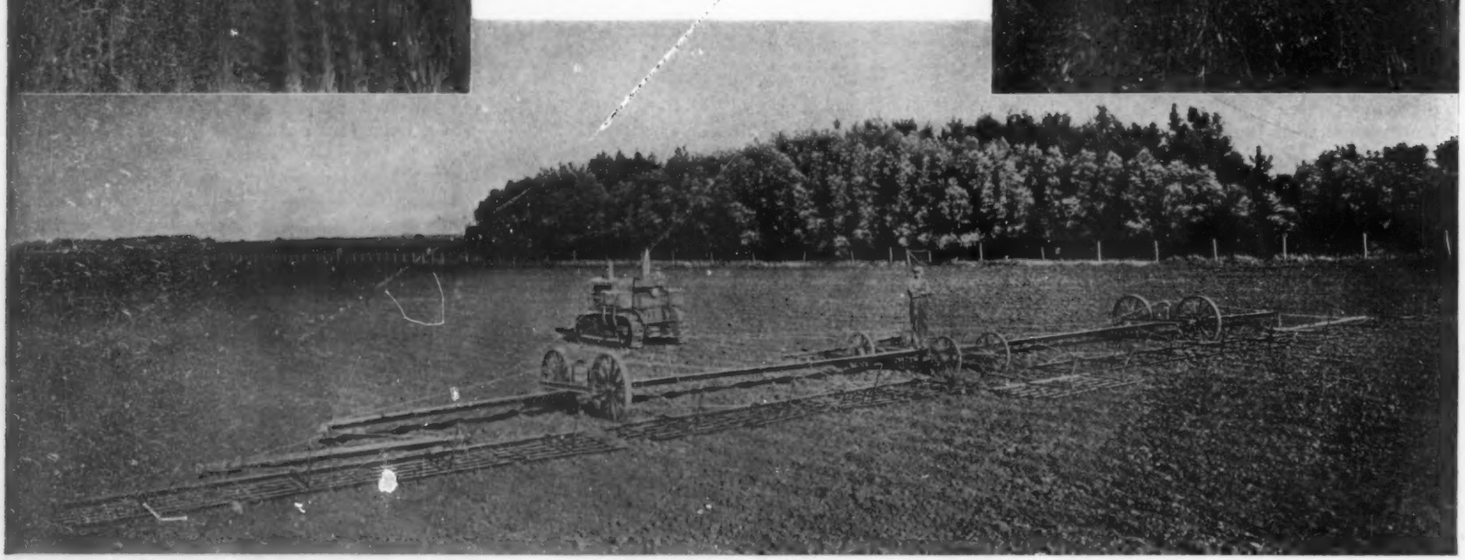
Machines Designed for All Harvesting

These labor-saving machines in the grain field have their counterparts in the harvesting of other crops. We have now the combined bean harvester and the combined clover seed huller. The corn picker and the ensilage harvester are working a revolution in corn growing.

Throughout the corn belt, and in all territories where it is not considered desirable to harvest the stalks, the field picker is destined to become the standard corn harvester. Indeed, so efficient are these machines that for one type the ability to pick pop-corn and green sweet corn for canning, is claimed. The picker picks and husks the corn ears and delivers them to an accompanying wagon, the stalks remaining in the field. Not more than two







SPEEDING UP FARM PRODUCTION

Upper left photograph illustrates a combined harvester and thresher. Center photograph shows a 10-ton caterpillar tractor drawing a 108-foot long harrow. In the upper-right illustration, a harvesting machine for sweet clover is shown

WAR ON BUGS

This sprayer can treat acres of crops each day

operators are required for the outfits, the tractor-drawn machines having a capacity of from 8 to 10 acres a day, as compared with about an acre and a half for a good hand-picker.

The ensilage harvester cuts the standing corn plant, stalks and ears, converts it into ensilage and delivers it to the accompanying wagon, thus saving the labor of five men on the ordinary silo-filling job. "Bringing in the sheaves" and "when the corn is in the shock," although time-honored and picturesque phrases, imply conditions of altogether too much inefficiency and drudgery to be endured.

Root and textile crops are also yielding to mechanical harvesting. In addition to the familiar elevator potato digger, we now have sugar-beet harvesters. There are a dozen or more French and German machines of this type. Although there seems to be but one American design commercially manufactured, it offers greater practical advantages. This machine cuts the tops from the beets, lifts the roots from the ground, and puts them in piles so that they can be readily picked up. There is also an attachment for saving the tops.

Flax and hemp harvesting machines are passing out of the experimental stage, and there has now been developed a cotton harvester which makes use of the basic idea of suction—the same principle as that employed in the vacuum sweeper familiar to the housewife. This machine is mounted on a Fordson tractor and can be driven through the rows without damage to the cotton plants. The speed of the operators using the machine is about five times that of hand pickers. While the machine has not as yet found extensive enough employment to exert an economic influence, of all the many inventions designed for cotton picking it is by far the most practical and may some day be considered as epoch-making as Whitney's cotton gin.

Although the garden tractor is a small machine, its importance should not be minimized; for these small power plants that supersede horse or man power in garden tillage bid fair to revolutionize the intensive farming of the world. Their advantage lies not only in the fact that they multiply the output of the laborer from three to five times but in that, unlike the horse, they do not need feed or attention when idle; and they will serve to bring into production small farms and city and suburban lots which are now idle, where cultivation with the horse would be impossible. This feature gives to these small automotives an opportunity of the first magnitude in transforming the life of crowded agricultural countries. What they may ultimately do for Japan, China, Java, India and other oriental agricultural nations may mean more for the peace and prosperity of the world than the work of the great machines of the grain fields.

Farm Owners May Decrease

Unforeseen events may deflect, annul or delay that which seems to be a steadfast tendency; but it seems by no means presumptuous to say that, viewing these changes in farming methods not as past isolated events but in prospect—as an accumulation of possibilities—the increased efficiency of the agricultural laborer will bring a further relative decrease in rural population and a release of still more workers to carry on manufacturing and commerce.

Comparisons between the prevailing methods of farming and those of our colonial forefathers, or of the drudging peasants of backward lands, are a bit too familiar to deserve repetition; nor are they exactly apposite, for they are out of date and consider only to the slightest extent, the employment of mechanical farm power. The newer methods are of too recent introduction to more than give a hint of their influence on the shift of labor demand; but even now, through large sections of the grain belt, the combined harvester has made the hobo harvest hand—a familiar figure five years ago—a rare species.

The increase in working capital required will tend

SMALL TRACTORS FOR SMALL FIELDS

These motor driven weeders are exceptionally efficient

to enlarge farming units, transforming the small farm into a vegetable and fruit producer that will not attempt competition with the extensive plantation using large and efficient machinery. An increased measure of geographical specialization in grain and staple crop-growing will follow, and excessive crop diversification will show itself an economic fallacy. On the other hand, the sugar beet harvester, the cotton picker, the bean combine and a score of other specialized farm machines will tend to extend the territory of other crops.

There is another feature involved in this evolution of the man with the hoe into the man with the monkey wrench. It is the increasing part played by the plant breeder. Heretofore, our efforts have been largely along the lines of designing machinery to fit the crops they plant, cultivate and harvest. Now we are beginning to produce new varieties of plants to fit the machinery—new varieties of crops which lend themselves more readily to mechanical operations.

All this, you might say, takes the guess-work out of farming and make it more profitable. Yes, but it does not necessarily follow that every man on a farm will grow independently rich. A tin Lizzie costs more than old Dobbin. The more machinery you have the greater is the initial capital you have to invest. This fact may well mean fewer farm owners and more tenants.

CORN PICKER

Ears of corn are gathered without cutting the stalks

BEET HARVESTER

The beets are pulled, tops cut off and the roots piled up

Do You Know How to Get Along with People?

Why Some People Get Ahead in the World While Others do Not

By Dr. F. A. Moss
George Washington University

THIS is the age of diplomacy. The polished sword has been supplanted by the polished word. The terrifying growls of anger have yielded place to the soothing words of tact. In the pioneer days, when might was right and every man was a law unto himself, diplomacy meant little. But times have changed.

A careful study of the qualities of the so-called successful man will reveal in nine cases out of ten that his success depends not on the deep and profound something which puzzles the brains of the average man, but on the simple and more superficial something which pleases the understanding of the common folk, and arouses in their hearts a feeling of sympathy. It is that congenial something which, for lack of a better name, I have defined as "social intelligence," or ability to get along with people; while the profound something, I define as "abstract intelligence," or the ability to deal with ideas.

Abstract intelligence is a sort of sixth sense which explores the uncanny depths of science; social intelligence has none of the mysterious qualities of a sixth sense, but it is the life of all the five. It is the ready eye, the quick ear, the judging taste, the keen smell, and the lively touch. It negotiates all difficulties, and avoids all conflicts.

For all practical purposes of life, social intelligence wins over abstract intelligence, ten to one. Abstract intelligence knows what to do, but social intelligence knows how to get it done. Those with high abstract intelligence win the laurels of scholarship, and are crowned with membership in *Phi Beta Kappa;* but later those who crowned them are disappointed that they get along no faster. Those with high social intelligence rarely attain the best grades, but they are usually rewarded with all the offices that it is in the power of their fellow students to bestow, and later in life their former instructors are astounded that they get along so fast.

In no trait do people differ more than in their ability to get along with others. And, as pointed out above, social intelligence is one of the most important elements making for success.

Realizing this, the authorities at George Washington University are attempting at the beginning of the freshman year to measure the social intelligence of each student in order to be able to assist him more intelligently in selecting courses and in planning a career in keeping with his natural aptitudes.

To discover the social ability of the various students a novel series of social intelligence tests was developed by the Psychology Department. These tests were given to all the students who entered the university this year, and are being tried out in a number of other institutions.

Several industrial concerns are also beginning to use these tests in selecting employees for positions where ability to get along with others is important.

Can You Place People?

In order that you may see what the test is like we will let you try parts of it. One of the most important factors in social intelligence is the ability to recognize faces and remember names. The person who gets along best with others does not have to be introduced to a man three or four times before he remembers that he has met him before. Knowing that it tickles the vanity of the average person to feel that he is remembered, the skilled salesman, if he calls at a place of business a second time, makes it a point to address the prospective customer by name. The pleasurable effect of being recognized and called by name has been known by the politician from the time of the ancient Egyptians.

Two things are measured in this test. One is the ability to recognize a face which has been seen before, and the other is the association of the correct name with the face. As a rule the man who is best at recognizing faces is also best at remembering names, but it occasionally happens that an individual may remember having seen ten different people and not be able to recall the name of a single one. Statistics on our first 1,000 cases show that people recognize faces much more often than they remember the names.

If you wish to test yourself on ability to remember names and faces you can take out your watch and study the twelve faces on this page carefully for four minutes in order that you may be able to recognize them when you see them in a larger group. Do not turn away immediately but read what is said about test one so that the usual time will elapse between first seeing this group of faces and having to recognize them in a larger group. You should study these twelves faces very carefully, for only about one in 400 makes a perfect score. Of the first 500 students tested at George Washington University only one remembered all the names and faces, and he is the son of a very popular United States Senator. Other things being equal, it seems that he might follow in the footsteps of his father.

A second factor of considerable importance in dealing with people is the ability to size up properly a social situation and to exercise correct judgment in meeting difficult social problems. In order to test this, 30 situations are given which require keen judgment, and a deep appreciation of human motives, to answer correctly. Four solutions are suggested to each situation, only one of which is correct. The person taking the test is instructed to place a check in front of the answer which in his opinion most satisfactorily meets the situation. Three samples follow:

1. Henry Burton has held a subordinate position with a business firm for ten years. During this time the work assigned him has been quietly and reliably done. He is a man whom his employers will miss when he is gone. On obtaining an appointment with a new firm he will be likely to:
—Assume advisory responsibilities easily.
—Impress his new employer immediately with his value to the firm.
—Be slow at creating opportunities for himself.
—Resign on receiving a slight criticism of his work.

2. While burying their uncle, Tom proposed to four of his cousins that each deposit $20 in their uncle's casket. When the other four had each dropped in $20 in currency, Tom took the $80 and put in his check for $100. The thing which prompted Tom's conduct was most likely:
—Craftiness.
—Ancestor worship.
—Devotion.
—Superstition.

3. The bodies of an unscrupulous politician and a woman other than his wife were found in a lonely wood. The man had been shot twice,

ONLY ONE IN FOUR HUNDRED SUCCEED IN THIS TEST

Study these faces for four minutes, then see if you can recognize them in the larger group on the opposite page

LOCATE THE TWELVE MEN ON THE PRECEDING PAGE

( ) *Mike Bailey*; ( ) *Clifton Clark*; ( ) *George Cook*; ( ) *Tom Edwards*; ( ) *Ben Elliott*; ( ) *Lee Higgins*; ( ) *Howard Jones*; ( ) *Jake McDonald*; ( ) *John Moore*; ( ) *Chester Sims*; ( ) *Sid Smith*; ( ) *Fritz Wagner*

the woman three times. Prints of a sharp heel were found on the face of the murdered woman. The person who committed the murder was most likely:

—A lover of the murdered woman.
—The wife of the murdered man.
—A political opponent.
—A fanatic reformer.

Now if you will take out your watch again and look at the group of 18 pictures on this page, you will find the twelve individuals whose photographs and names you saw in the first group. Below the cut are the names of these twelve individuals. From the group of 18, pick out the 12 persons whom you have seen before, and write the number of each of these 12 in the parentheses before the name with which it goes. Do not take over four minutes on this part of the test.

Can You Read Faces?

A third factor of considerable importance in social success is the ability to appreciate correctly the mental state back of certain facial expressions. To know the thoughts of others one must depend more on the eye than on the ear. The language of facial expression is the oldest and truest of all languages, for it is instinctive and in only a very small measure subject to the will. The would-be diplomat who is unable to tell by a person's facial changes whether he is indifferent, mildly interested, or greatly concerned has little chance of selecting the most effective means of clearing up a difficult situation.

An effort was made to measure this ability by giving a series of twelve photographs representing as many mental states. The names of these mental states are given in a list below the pictures. In the parentheses before each mental state is to be written the number of the picture which most correctly represents that mental state. It will be interesting to test yourself on the four samples which are shown on this page.

Everyday observation and good commonsense show a person that certain things work in the control of behavior, while other things are doomed to failure. One's ability to deal well with people is reflected in the correctness of his observations of human behavior. The one who is most adept at getting along with people will in general be the one who is most interested in people and who has most accurately observed their behavior. The extent to which one has profited by observation of those around him is tested by presenting the person taking the test with 30 generalizations on human behavior, some of which are correct, while others are incorrect. He is instructed to indicate whether in his judgment the generalization is true or false by encircling the T or the F in front of each generalization. You can test yourself with the following samples:

T F All men are created equal in mental ability.
T F We generally like those who bring us good news.
T F We are more shocked by our errors in etiquette than by those in logic.
T F One of the surest methods of bringing a man to your point of view is by engaging in argument with him.

The next test is devised to measure the extent of a person's social information. Other things being equal, the more things with which a person is acquainted and in which he is interested, the more able he will be to appreciate the interests of others.

In order to get some measure of the range of an individual's information, fifty statements, requiring knowledge of sports, automobiles, theaters, moving pictures, politics, current magazines, science, literature, organizations, travel, art, music, mechanics, etiquette, and items of everyday information were included. Test yourself on the following samples:

T F The nickname of the Chicago Nationals is Red Sox.
T F The term "right bower" is used in playing bridge.

WHAT EMOTIONS ARE DEPICTED?

( ) *Astonishment*; ( ) *Bashful appeal*; ( ) *Contentment*; ( ) *Coquetry*; ( ) *Delight*; ( ) *Determination*; ( ) *Grief*; ( ) *Physical suffering*; ( ) *Rage*; ( ) *Scorn*; ( ) *Suspicion*; ( ) *Terror*

T F To become a Shriner one must first join the Masons.
T F "Abie's Irish Rose" is a musical comedy.
T F The Lincoln automobile is made by Henry Ford.

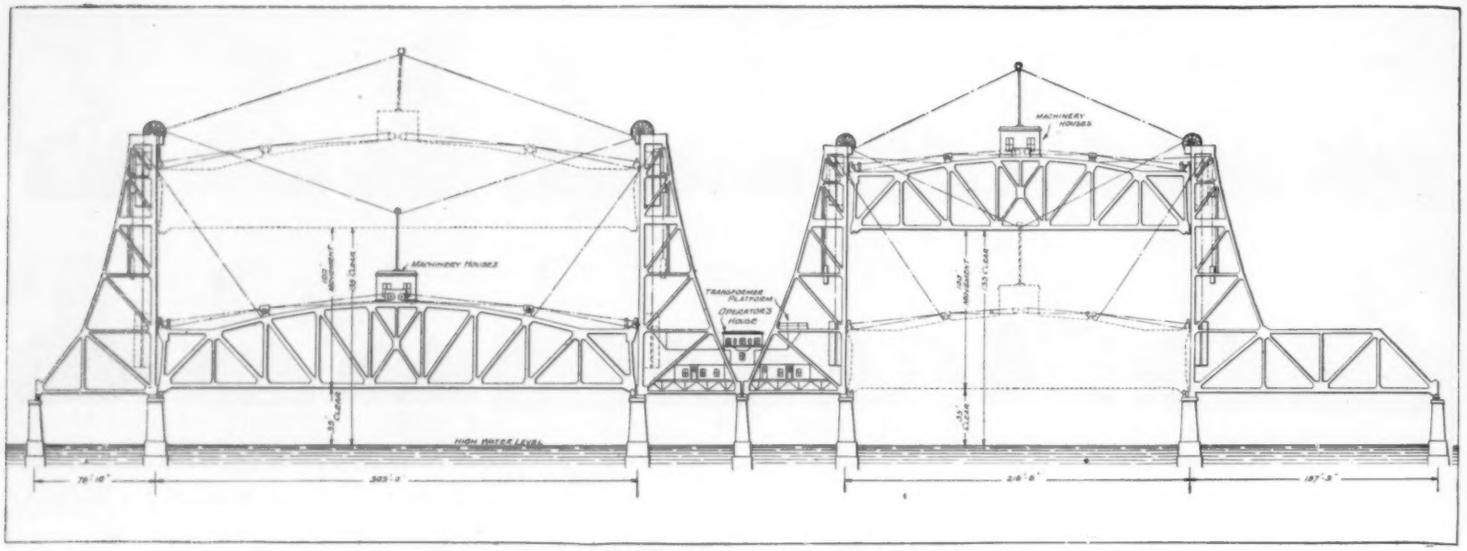
The last test measures one's ability to recognize the mental state of the speaker, or the motives back of the spoken word. It is well known that the mere words that a person says, unanalyzed, mean little, but the mental state back of these words is often of paramount importance. In order to test one's ability to appreciate the motive back of the spoken word, twenty-seven quotations are given. A list of mental states, such as ambition, despair, determination, disgust, fear, hate, jealousy, love, regret, scorn, and suspicion are given. The person taking the test is instructed to write in the parentheses before each quotation the mental state or motive from the list which prompted the words. You can test yourself with the following quotations:

( ) He has a very ancient and fish-like smell.
( ) Nay then, my last hope is gone—I can fight no longer.
( ) When I make up my mind to do a thing it gets done; and this is one time that it's going to be done my way.
( ) Cursed be my tribe if I forgive him!
( ) There is something in his eyes that tells me he is not playing straight; that's why I locked the door.

Is Havelock Ellis Right?

In the preliminary analysis of test results on 1,000 college students many interesting things were discovered. For example, the average score of 500 men was about five points lower than the average score of 500 women. The highest possible score was 160 points. This is a sufficient difference to be worthy of note. To some people this greater social intelligence of women will not come as a surprise, for there have always been a few who believed in "woman's intuition," and several years ago Havelock Ellis called attention to the "greater affectability of the female mind."

Whence came this greater affectability or social sense of woman? Realizing that there can be no final answer, I shall give my opinion for what it is worth. For countless ages woman, being physically weaker than man, has had to do with tact and intuition what men did with brute strength. Being dependent upon the will of her cave-man husband she found that in order to live comfortably she must be able to discern his mood with a high degree of accuracy on a moment's notice. In short, she developed her intuition from her anxiety to anticipate his wish, avoid his displeasure, and at the same time lead him into doing the things she wanted done.



A SKELETON VIEW OF THE FOUR-TRACK BRIDGE

Side elevation of the two massive lift bridges of the Newark Bay bridge. The lengths of the spans are 305 and 216½ feet; the total lift is 100 feet

Latest of Our Great Bridges

An Old Two-track, Timber Bridge Replaced By a Steel, Four-track Bridge 7,411 Feet Long

By J. Bernard Walker

THE obstacle presented by Newark Bay to the construction of the main western railroads to and from their terminals on the Hudson River has led to some heavy bridge construction. The best known crossing of the bay is perhaps that of the Central Railroad of New Jersey. The present article describes the enlargement and reconstruction of this bridge, which is now approaching completion, at a cost of $13,500,000.

At the present writing, the traffic is carried upon a double-track, pile trestle which dates from the year 1865. Originally, the railroad terminated at Elizabethport on the west shore of the bay, and passengers and freight were carried from that town to New York—a distance of 12 miles—by side-wheel steamers. In 1860, the Legislature permitted the extension of the road across Newark Bay. The timber bridge was about 9,741 feet long with a draw span which provided two 75-foot openings. This was replaced in 1888 by a pin-connected truss, and that, in turn, in 1905 by two double-track Scherzer rolling lift spans.

Entirely of Steel Concrete

This famous old structure has been carefully maintained during its 60 years of service, but the high standard of maintenance, coupled with the growth in weight of trains, has caused the structure to be continuously rebuilt, so that long ago the original material in the bridge disappeared.

Contemporaneously with the growth of traffic, there has been such an increase of water-borne traffic up and down the bay, that in 1924, some 57,000 vessels passed through the draw spans and called for over 19,000 openings. The underside of the deck of the bridge was so low that practically all of the boats required an opening of the draw spans in order to pass through the bridge. A study of the situation revealed the encouraging fact that, if the underside of the new bridge were to provide a clearance above high water of 35 feet, about 60 percent of the traffic could pass under the bridge without requiring the opening of the draw spans.

It was decided to locate the new bridge alongside of the old structure, bringing the material to the site by water, thus enabling the regular train schedule to be steadily maintained without any interruption.

The new bridge is built entirely of steel and concrete—concrete for the piers and steel for the superstructure. The two openings through the bridge, which formerly were 85 feet wide, were enlarged to provide two openings of 200 feet and 125 feet, measured at right angles to the channel. Each opening is provided with a pair of vertical-lift, double-track draw spans with a total lift ranging from 35 to 135 feet above high water. Because the ship channels lie at an angle of about 60 degrees with the center line of the bridge, movable spans were required of a total length of 305 feet for the westerly and 216 feet for the easterly channel.

The decision to adopt the vertical-lift type of openings on this important main-line structure was reached only after a careful consideration of other types of opening. It was decided that a four-track, swing bridge with such wide openings would be so heavy as to involve difficult problems of construction and operation; furthermore, the War Department desired that there should be two independent channel openings—one or other of which could be used as desired. This, they pointed out, would have the advantage that, in the event of one opening being temporarily disabled, the other would be available and traffic up and down the fairway of Newark Bay would not be completely shut off. The bascule type was considered but it was found that it would cost about 10 percent more for the 125-foot opening, and 25 percent more for the 200-foot opening than would the vertical-lift type.

THE MILE-LONG APPROACH

Lowering a 124½ foot, 54-ton girder into position

All Spans Controlled by One Man

It was for these reasons that the vertical-lift type was selected—the design being prepared by Dr. J. A. L. Waddell working in collaboration with the engineers of the railroad. The design conforms to accepted practice, except that the counterweight cables within the steel towers are carried over multiple sheaves instead of single sheaves, attached at each corner of the bridges. It should be noted that each opening consists of two identical two-track spans carried side by side. The power for lifting and lowering the bridges consists of three-phase, 60-cycle, alternating current at 2,300 volts provided with low-voltage controls.

The total lift of the movable spans is 100 feet and the operating machinery is sufficiently powerful to lift the 200-foot span in one and one-half minutes, and the shorter span in one and one-quarter minutes. The multiple-sheave system was adopted with a view to avoid the excessive hub and axle pressures which have given trouble in previous heavy-lift spans. Although the first cost is greater, there is a reduction of 25 percent in the power, and the maintenance of the system is less expensive. It is considered that this installation is a marked improvement over the old system.

Each of the four spans is equipped with two 150-horsepower Westinghouse motors designed for high-speed operation. The alternating current is delivered to a substation at the west end of the bridge at

LAUNCHING A FLOATING CAISSON

These timber caissons were used in building the eighty-six piers that carry the long girder approach

26,400 volts, where it is stepped down to 2,300 volts and transmitted through two three-conductor cables to the motors. The maximum demand when all four bridges are raised simultaneously is about 1,300 kilowatts. The machinery houses are placed on the top of the individual spans. All four spans are controlled by one man in the interlocking tower which is placed in the center-tower span.

The spans were erected upon temporary false-work, one at a time, so as always to have one opening available for moving traffic. As soon as both spans were completed, they were raised to the high positions and the false-work removed. A great saving in the weight of the spans was secured by using silicon steel for the trusses and floor beams. The stringers and all other parts are of carbon steel. The maximum stress in the silicon steel is 24,000 pounds and in the carbon steel the maximum stress is 16,000 pounds.

Although the company will spend about $13,500,000 on the structure and approaches, the new bridge will bring no additional revenue to the railroad; but so great is the capacity, that a large future increase of traffic can be easily handled. When the bridge is opened, it no longer will be necessary to suspend freight traffic during the rush hours of the morning and evening. The train schedule calls for 240 trains across the bridge, and switching, transfer and other movements will bring the number up to a total of about 300 trains daily.

Some of the most interesting work of this great structure was done on the foundations, which included not only carrying the massive lift-bridge piers down to rock, but the construction of 84 piers for carrying the steel girders of the main portion of the bridge.

In view of the great length of the bridge and the extensive reduplication of parts, the engineers made a most careful study to determine the best type of piers, the most economical method for their construction, and the best type of steel superstructure for a bridge of this character. The War Department had fixed the length of the approach spans at 125 feet. The soil throughout the length of the bridge consisted of sand, gravel and clay, and it was decided to form the foundation of piles driven through to rock. The cut-off was made 20 feet below low-water level, and upon this were built up the solid concrete piers.

Articulated Cofferdams Used

The cofferdams were constructed upon a reinforced concrete cellular base, to which the timber walls of the cofferdam were securely bolted down. The cofferdams, after being thoroughly caulked and made water-tight, were floated out and lowered onto the pile foundation, and the construction of the concrete pier was then carried on by the usual methods —the cellular concrete base forming, of course, an integral part of the pier. When the concrete pier was completed, the sides of the cofferdam were unbolted and used in building other similar piers. Great attention was given to the designing of this work, so as to render the building, floating, sinking and subsequent dismantling of the cofferdams as economical and expeditious as possible. One manifest advantage of building articulated cofferdams was that it was possible to use the same sides many times over—some of the sections being used as many as twelve times in succession.

The superstructure, which is entirely of steel, called for a total of 328 plate girders, whose dimensions are: length, 124½ feet, depth, 10 feet 8 inches, and weight, 54 tons. The piers, for convenience, were built in two adjoining sections. There are eight girders to each double pier, or two for each of the four tracks. The footings for the girder spans are of especial interest. The fixed ends are of the hinge type; but the expansion ends make use of a single rocker in place of a nest of rollers. The rocker has the advantage of simplicity in construction and greater accessibility for inspection and

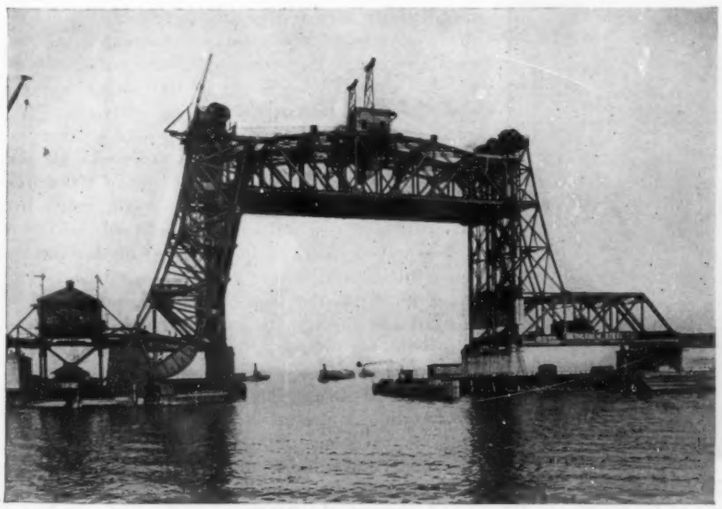
THE POWERFUL FLOATING DREDGE

Much dredging was required, the material being deposited at the shore end of the bridge

cleaning. An idea of the magnitude of this part of the work is gained from the fact that the task of transporting these girders from the American Bridge Company's works at Ambridge, Pennsylvania, to the bridge called for 20 round trips of a train made up of 56 flat cars.

Unlike the piers for the approaches, the all-concrete piers for the towers which carry the lift bridges were founded directly upon the underlying rock, which was found at a depth of from 50 to 70 feet. The determination to carry these piers down in solid masonry by the pneumatic system was made in consideration of the extremely heavy superstructure loads, and also of the fact that the War Department required the depth of the channel to be 40 feet. These piers differ from the approach piers also in the fact that each pier is a single structure extending the full width of the bridge. The caissons for each single pier measured about 25 by 100 feet. The sides of the caisson were built up to a height of about 40 feet before launching. It was then ballasted with concrete, towed out to the site, and then sunk to rock under compressed air.

We are indebted to Mr. A. E. Owen, Chief Engineer, and Mr. J. J. Yates, Bridge Engineer of the Central Railroad of New Jersey for the particulars upon which this description of a very notable and highly meritorious work has been written.

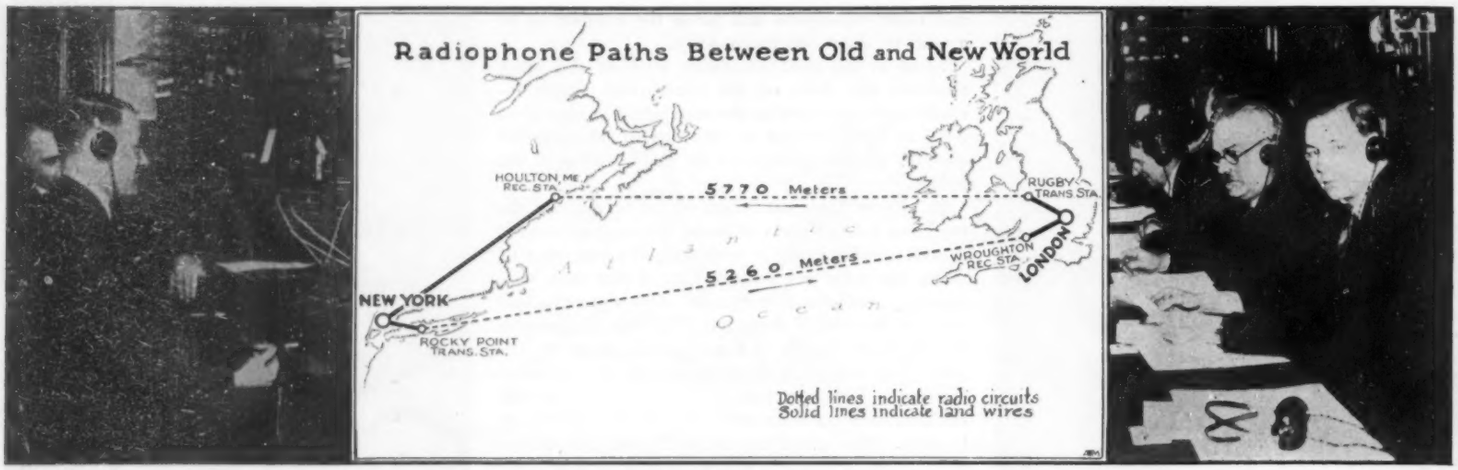


OLD AND NEW SPANS

This view shows the old rolling lift span and the new 216½-foot lift in the open position

TIMBER GIVES PLACE TO STEEL

The Newark Bay bridges, old and new. View looking west along the old timber bridge



International Newsreel

NEW YORK TALKS TO LONDON

At the left is pictured a scene at the American Telephone and Telegraph Company offices in New York. The map, in the center, is self-explanatory. At the right are shown British newspaper men at the General Post Office Engineering Department, London. For four hours conversation was carried on by radio across the ocean, with perfect results recorded.

Building a Talk-bridge Over the Sea

New Radio System Is Called "Single Side-band Transmission," With the Carrier Wave Suppressed

By Orrin E. Dunlap, Jr.

RADIO engineers are building an invisible talk-bridge to span the distance of 3,000 miles between New York and London, with the ultimate aim of establishing general radiophone service between the Old and the New World.

The experiments began in 1922, and they are still in progress with no definite clue as to when the vagaries of the ether will be conquered so that commercial service can be offered to the public. Sponsors of the tests on this side of the sea are the American Telephone and Telegraph Company and the Radio Corporation of America, while the British General Post Office is in charge of the operations at the English terminal. Rocky Point, Long Island, is the site of the American transmitter and Rugby, England, is the location of the British station.

Signals from the Long Island aerial are intercepted by a receiving station at Wroughton, England, 3,300 miles distant and are forwarded to the central office in London over 90 miles of land wires. Voices can be sent directly from New York, because 70 miles of land wires link the New York office with the transmitter at Rocky Point.

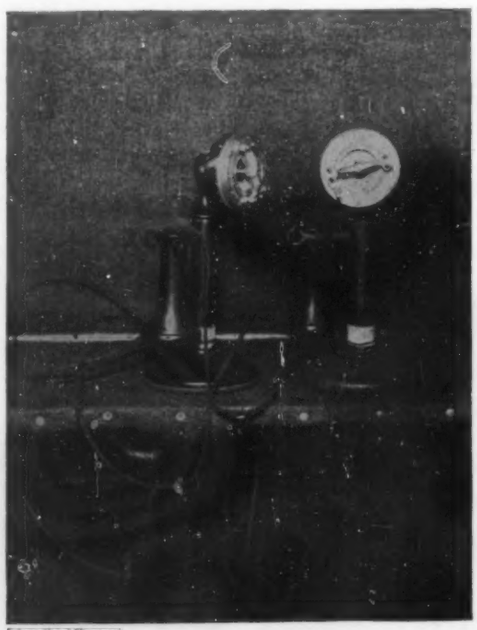
Secrecy Not Yet Practical

When the Britisher speaks in London, the words travel over wire lines to Rugby, a distance of 85 miles. The English waves are detected at Houlton, Maine, 2,900 miles from the Rugby towers. Six hundred miles of wire carry the impulses to New York. The receiving station is located in Maine because that state is one of the ideal spots in the United States for reception from European stations and there is less static interference in that locality than in the vicinity of New York.

The Rugby transmitter operates on 5,770 meters and the Rocky Point waves are 5,260 meters in length. The power outputs of both stations are rated at 150 kilowatts. The American call is 2XS and the British GBT.

Two factors which prevent the talk-bridge from handling commercial traffic at the present time are static and the fact that eavesdroppers can tune in on the international conversations, thereby limiting the demand for the service. It is pointed out that any business house or private individual making a radiophone call to Europe would naturally have a message of importance and naturally the sender would not want the entire world to listen-in.

Several plans have been presented and tests made of systems which scramble the waves and then unscramble them at the receiving station by means of special apparatus, thereby preventing eavesdroppers from learning the contents of the messages. When the service is finally inaugurated it will undoubtedly be protected by a method of shuffling and unshuffling the waves to confuse listeners at the international keyholes. British engineers are working on a system which lops off part of the voice at the sending station and grafts it back at the receiver.



International Newsreel

THE TELEPHONE'S NEW FACE

These are the mouthpieces employed for talking over the ether's channel to Europe. This attachment is fitted with a microphone in place of the ordinary transmitter

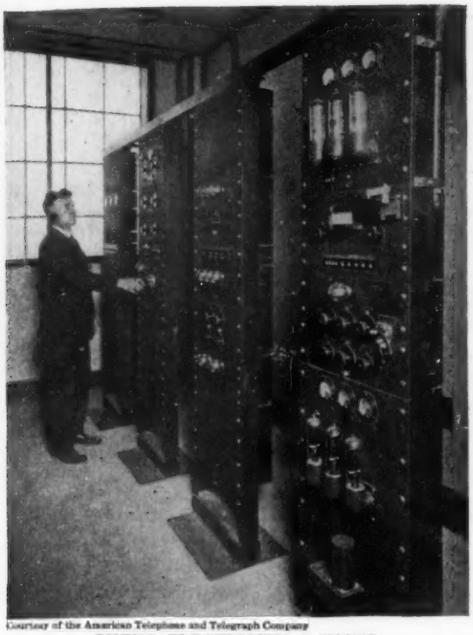
Five hundred vacuum tubes were needed in 1915 to hurl the voice across the Atlantic from Arlington, Virginia, to the Eiffel Tower in Paris, but the modern system requires only 35 tubes which produce 150 times as much power as the 500 audions which were linked in the circuit eleven years ago. This advance was made possible by the invention of a water-cooling system which prevents the bulbs from becoming hot. When electricity was applied to the old tubes they became hot after the current was increased to a certain point and the metallic elements in the lamps emitted gases which destroyed the vacuum. The modern tubes with their water-cooled jackets can handle 400 times as much current without injury to the metal parts or the vacuum.

Transmission Nears Perfection

The problem today is to reduce the mortality of words in their flight across the water. All words must be heard correctly before the system can be pronounced perfect. In the reception tests, disconnected words are used so that there is no chance of the receiving operator's imagination supplying the missing links in the sentences. During the summer of 1923 about 15 words out of 100, on an average, would survive the trip across the Atlantic. Last summer the transmission was improved so that the record was 60 out of 100 words received. On the average, during the past winter, 90 out of 100 words could be identified and during certain hours the complete word list was easily understood.

When there is a continuous band of daylight or darkness between America and Europe reception is good, but when the "sunset wall" is somewhere on the Atlantic the signals fade as the twilight creeps across the sea toward the west. The "sunrise wall" also has a detrimental effect. These barriers, which signalize sunrise and sunset, also cut off static, which to a great extent seems to originate in the tropics. Seasonal variations in the voice intensity are so great that under unfavorable atmospheric conditions it requires 10,000 times as much power to project the words through the 3,000 miles of space.

Data obtained from 40,000 individual measure-



Courtesy of the American Telephone and Telegraph Company

GIVING ELECTRICITY A VOICE

The low-power portion of the transoceanic radio telephone transmitter, including the speech input, modulating, filters and amplifying apparatus

ments in transatlantic radio-telephony revealed these principal conclusions: The sun is the controlling factor in the diurnal and seasonal variations in signal strength. Transmission from east to west and west to east exhibit similar characteristics. Transmission in the region bordering on the division between illuminated and darkened hemispheres is characterized by increased attenuation. Disturbances in the earth's magnetic field have a tendency to increase the daylight signal intensity and to greatly weaken the voices at night. In general, static noise is less on higher wavelengths, with the difference between day and night static apparently caused by daylight attenuation.

Full night-time signal strength is not attained until some time after sunset at the western terminal and the waves begin to weaken before sunrise at the eastern end. The daylight effects appear to extend into the period in which the transmission path along the earth's surface is unexposed to the direct rays of the sun.

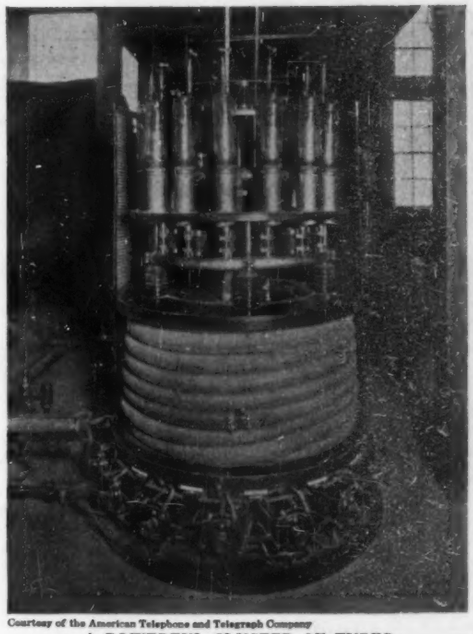
With the advance of the season from winter to summer, the time at which the maximum night-time value is fully attained occurs later and later. During the latter part of April the transmission path no sooner comes into ideal night-time conditions than it again emerges. But as the season advances into the summer, day conditions begin to develop while the night field strength is still rising. Then, as the sunlit area recedes south after the summer solstice, a time is reached, about the middle of August, when the full night-time values are returned.

"Side-band" Transmission Used

In the development of the transatlantic circuit the engineers have introduced what is known as the "single side-band suppressed carrier" method of transmission. The ordinary broadcasting stations radiate three bands of electrical waves, which are sent through the ether. The central band is called "the carrier." The one side-band extends upward and the other downward from the carrier wave. The former is known as the "upper side-band" and the latter as the "lower." The frequency-widths and amplitudes of each band are the same as the frequency-width and the amplitude of the original wave but the power at the carrier frequency is more than two-thirds of the total.

The transoceanic system radiates only one side band without the carrier. The advantages of this method are: all the power radiated is effective in conveying the message; transmission is more stable; the frequency band is reduced, thus conserving wavelength space in the ether and simplifying the transmitting aerial problem.

The engineers explain that it is not necessary to transmit both side-bands. Therefore, in the new method one side-band is suppressed by electric filters. Furthermore, the carrier wave is merely a continuous alternating current and does not share the signal variation. It does not matter whether the carrier is transmitted or is supplied to the detector from a local source. For this reason the carrier is suppressed by filters from the modulated wave sent out from the transmitting aerial. But the carrier is reintroduced in the receiving circuit from a local source. This is termed "homodyne" reception, since a wave of the same frequency as the eliminated carrier is supplied to the receiver by a heterodyne oscillator.

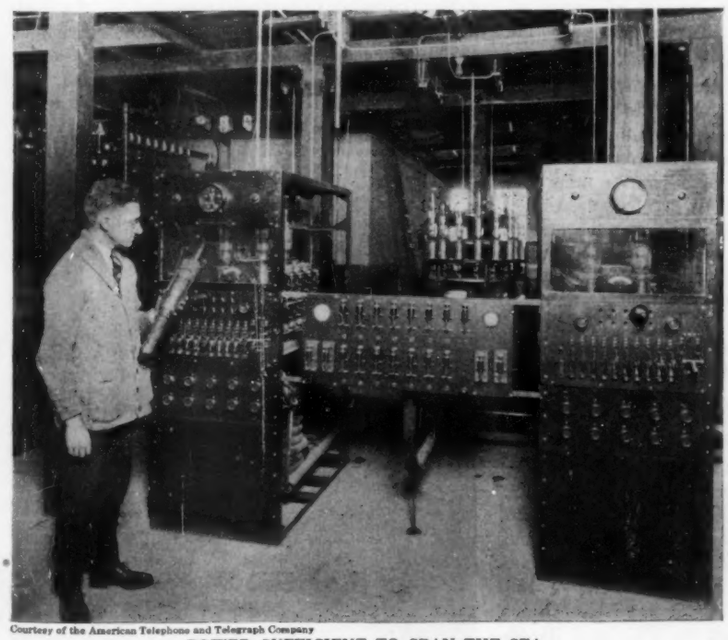


Courtesy of the American Telephone and Telegraph Company

A POWERFUL CLUSTER OF TUBES

The circular bank of fifteen water-cooled amplifiers. The coil of hose conveys the water to cool the tubes. The water circulates in the metal jackets

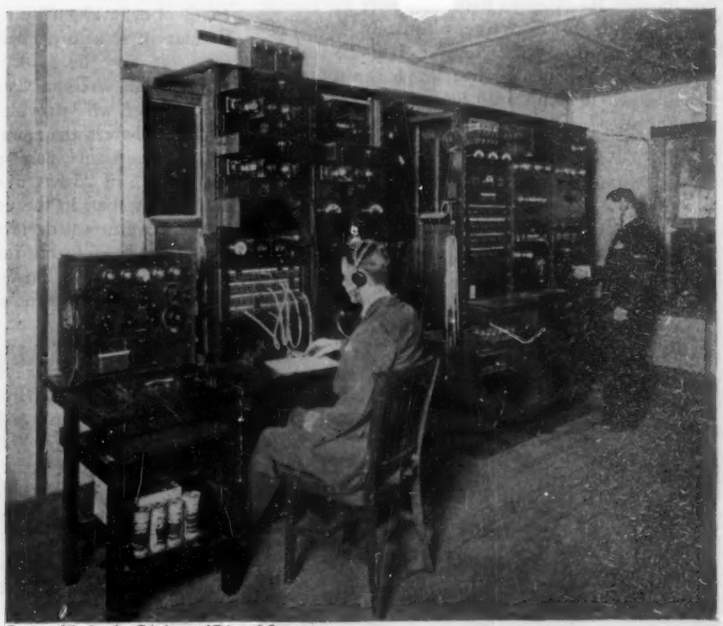
In ordinary broadcasting the energy is transmitted at the carrier frequency, at the frequencies in the upper side-band and at frequencies in the lower side-band. The carrier is the radio frequency modulated by the audio frequency. The upper side-band includes the frequencies extending from the carrier upward and the lower side-band includes frequencies downward from the carrier. In regular radiophone broadcasting the carrier frequency component comprises about 66 percent of the total power and, inasmuch as it does not convey the message, it is extracted from the side-band system. Each side-band transmits the message, so that one can be dispensed with as is the case in the overseas circuit, leaving the single side-band as the pathway for all traffic.



Courtesy of the American Telephone and Telegraph Company

POWER SUFFICIENT TO SPAN THE SEA

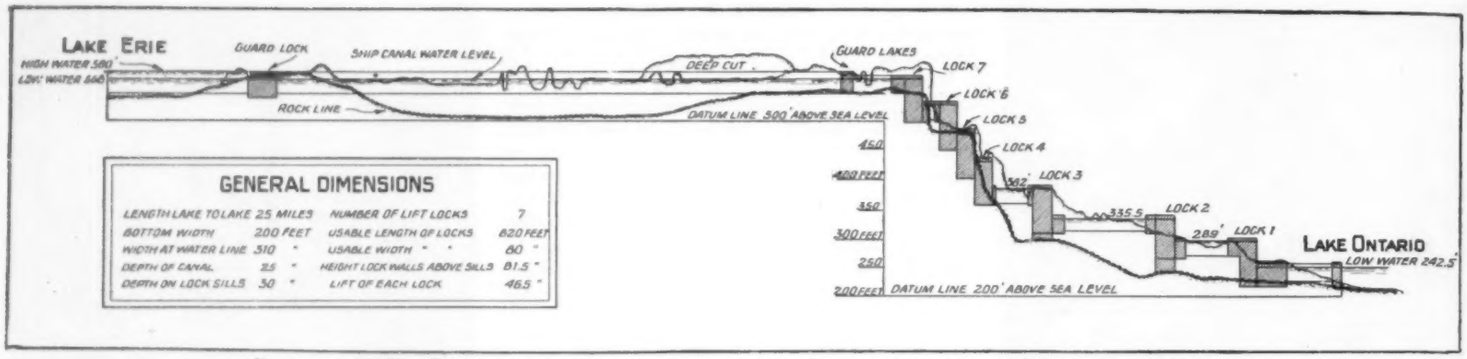
The high-power section of the transatlantic installation. Two banks of the high-power water-cooled amplifying tubes are in the foreground. The output is 150 kilowatts



Courtesy of the American Telephone and Telegraph Company

WHERE RADIO AND LAND WIRES MEET

Interior of the American transatlantic radiophone receiving station. The radio receiver is at the left. At the right is the telephone testboard and amplifier for the wire circuit



PROFILE OF THE NEW WELLAND CANAL. NAVIGABLE DEPTH, 25 FEET; DEPTH TO LOCK SILLS, 30 FEET; LENGTH, 25 MILES

The Welland Ship Canal

Progress on a 25-foot Waterway With 30-foot Locks that Will Open the Great Lakes to the Ocean

By J. Bernard Walker

BEFORE describing the great undertaking which is known as the New Welland Ship Canal, let us consider the topographical relation of those vast inland seas known as the Great Lakes to the St. Lawrence River and the Atlantic Ocean. Lake Superior—the most westerly of these bodies of water—stands at an elevation of 602 feet above sea level. Its surplus waters flow into Lake Huron through the St. Mary's River, whose rapids are overcome by the famous Sault Ste. Marie locks, which include twin locks in the United States Canal carrying a maximum of 26 feet of water on the sills. Through these locks, boats of 25 feet draft can pass from Lake Superior to Lakes Huron and Michigan. From Lake Huron ships can proceed by way of the St. Clair River and channels dredged in Lake St. Clair and the Detroit River to Lake Erie, which has a mean surface elevation of 572.5 feet. Here large lake freighters must stop, for the reason that the depth of water over the sills of the old Welland Canal locks is only 14 feet. From Lake Erie, the surplus waters flow through the Niagara River and over the famous Niagara Falls to discharge ultimately into Lake Ontario, whose low-water elevation is 242.5 feet. It is this great drop of 330 feet which constitutes the main obstacle to ship transit between the Great Lakes and the sea.

As matters now stand, the 14-foot Welland Canal is the only waterway from Lake Erie to Lake Ontario. From Lake Erie to the sea, there are two waterways—one by way of the Welland Canal, Lake Ontario and the St. Lawrence River, the other from Lake Erie, near Buffalo, to Troy on the Hudson River, and thence by that river to the sea. The former route has a limiting depth of 14 feet, both in the locks of the canal and also in the various locks by which the rapids of the St. Lawrence River are overcome between Lake Ontario and the port of Montreal. The other canal—known as the New York State Barge Canal—has a limiting depth of 12 feet over the lock sills.

Two Proposed Ship Canals

As the public is well aware, there are two projects for opening a waterway of sufficient depth to accommodate sea-going ships from the Great Lakes to the sea. One of these is by way of the Welland Canal and a deepened St. Lawrence River; the other is by way, mainly, of the present Barge Canal and the Hudson River. Since the ultimate depth of any canal is determined by the depth of water over the permanent structures, such as the sills of the lock gates, it may be said that the 25-foot waterway through the Welland Canal and down the St. Lawrence River will provide for an ultimate depth of 30 feet, whereas the route by way of the New York State Barge Canal, as at present suggested, provides for a depth of 25 feet over the sills. We think it is safe to say that, in the unlikely event of the United States Government deciding to take over the present barge canal and turn it into a ship canal, the Government engineers will take a firm stand in favor of building the permanent structures with a minimum depth of 30 feet.

A glance at any map of the region around the Niagara River shows that Lake Erie and Lake Ontario are separated by a rather narrow peninsula of land which measures in width, as the crow flies, about 24 miles. For the first 18 miles from Lake Erie, the river flows through fairly level country with a rather steep fall of the river for the last few miles. Here it comes to a great cliff or escarpment into which it has worn its way back for several miles and over which it thunders in the world-famous Niagara Falls, with a drop at the Horseshoe Falls of 155 feet and at the American Falls of 162 feet. Thence it flows swiftly down through the Whirlpool Rapids and on to Lake Ontario.

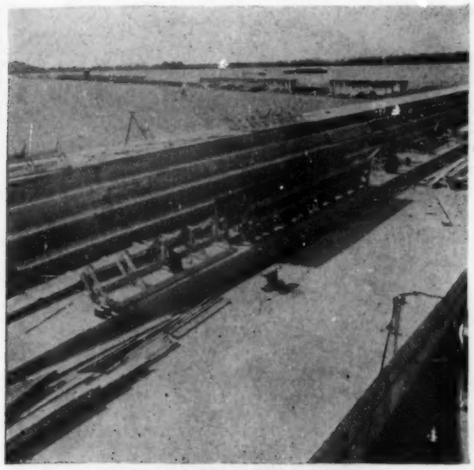
Now, if the visitor were to stroll to the westward of Niagara River below the falls, he would find that the great escarpment extends along the peninsula more or less parallel with the shoreline of Lake Ontario; and, ten miles from Nigara, he would come upon a series of imposing engineering structures representing the transformation of the old 14-foot Welland Canal into the new 25-foot ship canal—a work the magnitude of which is shown in the accompanying diagrams and photographic views.

It may come as a surprise to many of our readers to learn that the Welland Canal enterprise celebrated its centenary on November 30, 1924, and that the present 25-foot canal will be the fourth to bear that name. The first, begun in 1824 and completed in 1829, had 40 wooden locks with a depth of 8 feet on the sills. In 1850, there was opened the second Welland Canal, when the number of locks was reduced to 27, built of cut stone with 9 feet of water on the sills. This canal is now used for power purposes and all of its locks are still in existence. In 1853, the depth was increased to 10 feet by raising the banks of the Canal and the walls of the locks.

The Dominion Government now took up the question of inland navigation and the Commission of 1870 recommended a uniform scale of navigation for the Welland Canal and the St. Lawrence route, with locks having 12 feet of water on the sills, which was later increased to 14 feet. This, the third canal, 26¾ miles in length, was opened for 14-foot naviga-

ENTRANCE FROM LAKE ONTARIO
This photograph gives an idea of the massive character of the lock construction

LOCK NUMBER 2, LOOKING SOUTH
All the locks of the canal are 30 feet deep, 80 feet wide and 820 feet long



PORT COLBORNE BREAKWATER
This photograph shows a stretch of the complete concrete superstructure of the great breakwater

tion in 1887 and the St. Lawrence River canals were placed in service in 1901. This canal has cost for construction about $24,000,000 and about $12,000,000 for repairs and maintenance. The Welland and St. Lawrence Canals between Lake Erie and Montreal have cost Canada about $87,000,000 on capital construction, and about $28,000,000 for repairs and maintenance.

In 1901, the total tonnage passing through the Welland Canal was about 620,000 tons. By 1914, it had increased to 3,860,000 tons, showing that, due to increased facilities, the St. Lawrence route had gradually drawn more heavily upon the Great Lakes-Atlantic seaboard trade. The Great War withdrew many lake vessels into high-sea service, and traffic through the Canal fell off from 3,860,000 tons in 1914 to 2,200,000 tons in 1918-19; but since this latter time, traffic has been growing rapidly year by year, with a new maximum annual tonnage record of 5,037,412 tons, established in 1924.

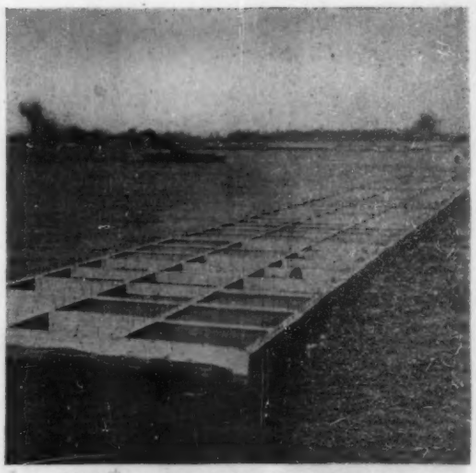
The short-sighted policy of 1870 left the Welland Canal as much out of date in 1887 as it was when the improvements were begun in 1873; whereas a moderate increase in the length of the locks alone would have enabled a large part of the fleet of 1901 to descend to Montreal, instead of being confined to the Upper Lakes. These canals, locks and river channels are entirely inadequate for use by the Great Lakes steamers of today, and can now be considered as of little more than barge size. The improvement of the Welland and St. Lawrence Canals to such dimensions as would accommodate ships of at least 25-foot draft has been contemplated for many years. During the past quarter of a century, exhaustive surveys have been made to determine the feasibility and cost of such a waterway and another survey has been carried out recently by the International Joint Commission. Following the opening of the St. Lawrence Route in 1901 for vessels drawing 14 feet of water, the Canadian Government began improvements to the Port Colborne entrance of the Welland Canal, these consisting of deepening the harbor to 22 feet, constructing a million-bushel modern concrete elevator (completed in 1908), and building large breakwaters. So great has been the increased movement of grain through the Welland Canal, that the Dominion Government has twice found it necessary to add to the original Port Colborne elevator, first in 1912-13 and again in 1923-24, each addition increasing the capacity by one million bushels. The elevator and its extensions are already taxed to the limit of their 3,000,000-bushel capacity.

The total length of the new ship canal is 25 miles and the difference in level between Lake Erie and Lake Ontario is overcome by seven locks, each having a lift of 46½ feet. The topography of the lower plateau and the fact that the canal extends in a direct line down the face of the escarpment permitted the adoption of lifts of this height. They are a peculiar feature of the design of the canal, and there was no precedent in any previous construction for locks of their size.

Total Cost About $110,000,000

The cross sections of the canal show that it will be 200 feet wide on the bottom with slopes of two feet horizontal to one foot vertical. The sections which were let by contract in 1921 have been excavated to a depth of 25 feet, but the rest of the work is being carried down to a depth of 27½ feet. All masonry structures, however, are being built for a draft of 30 feet. Hence the canal, whenever it is so desired, can be deepened by simply dredging out the canal prism and the harbor entrances. Port Weller on Lake Ontario and Port Colborne on Lake Erie are now being dredged to give a 27½-foot draft where severe wave action may be expected.

The canal has seven lift locks and one guard lock, as shown on the accompanying profile. Three of these are twin locks in flight, arranged similarly to the Gatun locks of the Panama Canal. The locks will have a usable length of 820 feet, a usable width of 80 feet and a depth of water on the sills of 30



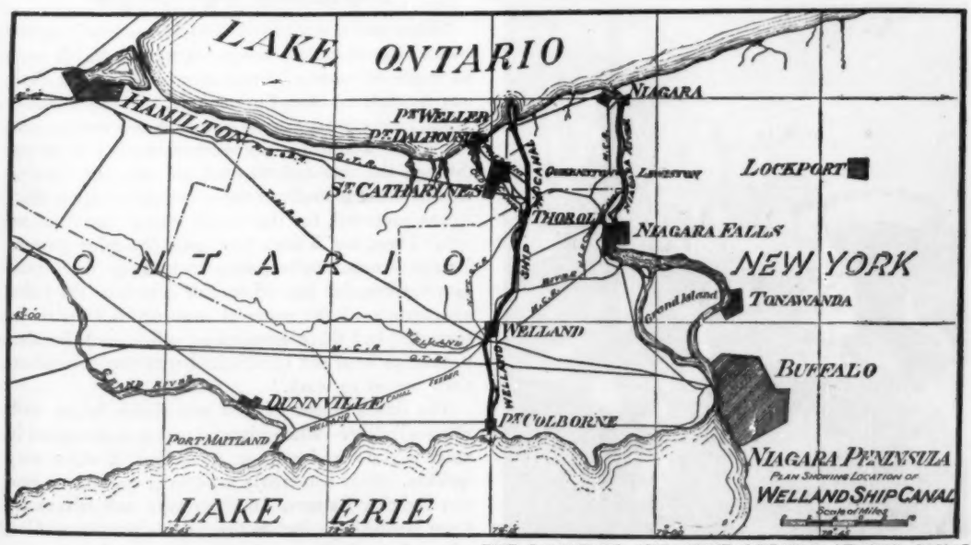
BREAKWATER AT ONTARIO ENTRANCE
The concrete, rock-filled cribs upon which the concrete monolith superstructure was erected

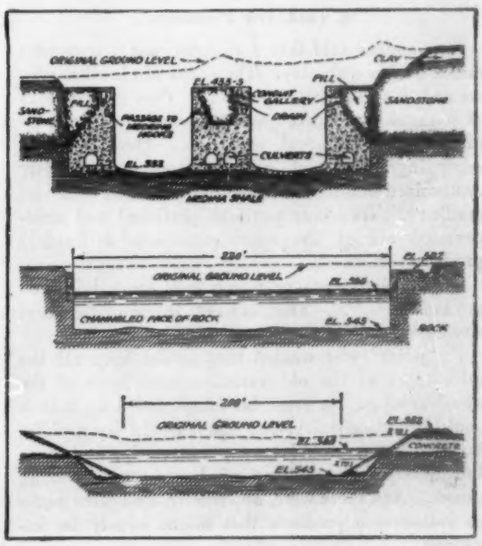
feet, the lift of each lock being 46½ feet. For the 25-foot depth, the width of the canal at the waterline will be 310 feet. The lower mitre gates are 82 feet high, and the approximate weight of each leaf is 425 tons. The total estimated weight of metal in the lock gates and operating machinery is 12,300 tons, and the estimated motor load for operating the canal and the Port Colborne elevator of 3,000,000-bushel capacity, is 11,200 horsepower. It will take eight minutes to fill a lock; and the estimated time for a vessel to pass through the canal is eight hours.

In addition to the work on the canal itself, there has been some very heavy construction for the harbors at each end, notably at Port Colborne, where massive breakwaters were required to protect the approach to the canal.

The expenditures to the end of March, 1925, on the new canal had reached $50,000,000, including the engineering expense and the purchase of the right of way. It is estimated that the canal will be ready for operation about 1930, when the total cost will have been about $110,000,000. We are indebted for our data and illustrations to the courtesy of Mr. Alexander J. Grant, Chief Engineer of this great work.

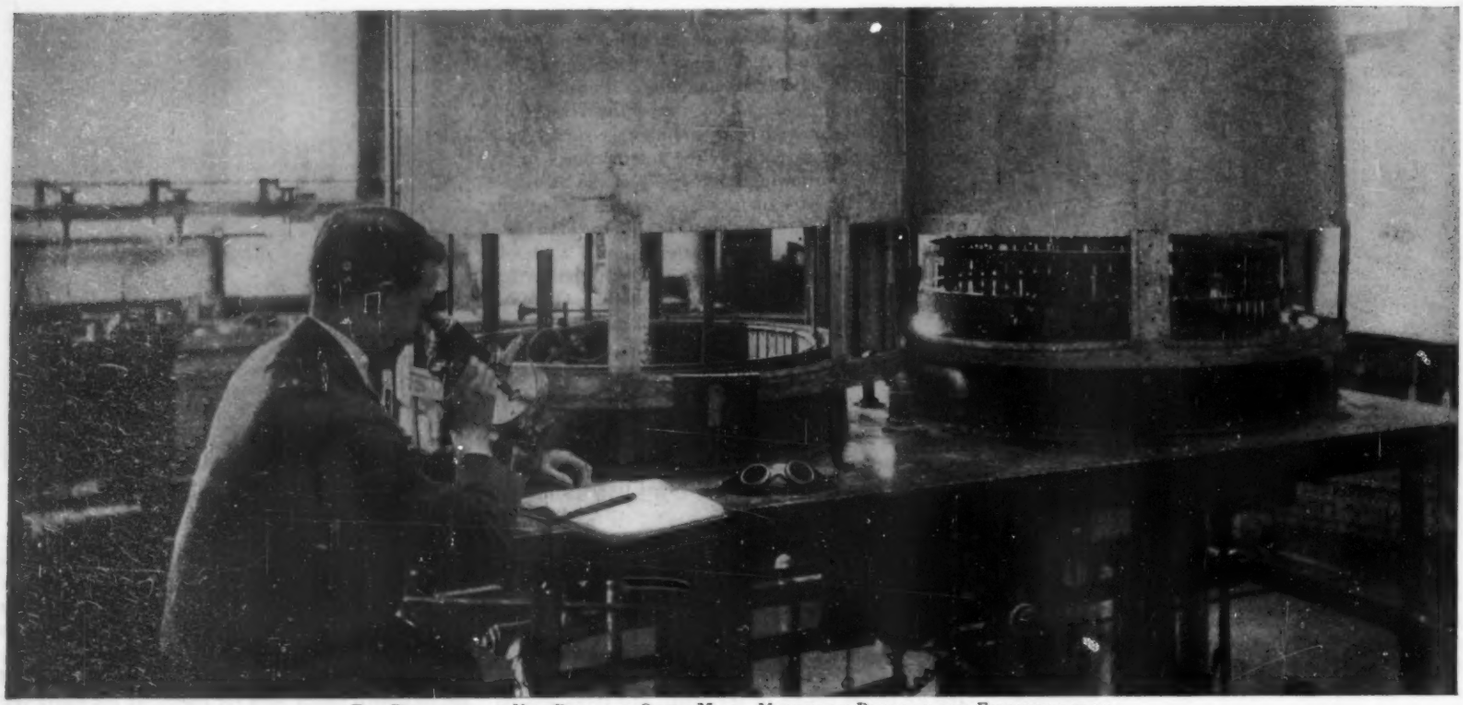
¶ *In an early issue will appear an article on the first decade of operation of the Panama Canal, which was opened to traffic in 1914 and has a most romantic history.*





THE LOCATION AND SOME DETAILS OF THE CANAL

LEFT: *Map showing relation of the Welland Canal to Lakes Erie and Ontario, and to the Niagara River.* RIGHT: *Sections through twin locks and through canal in rock and in earth*



THE PERFECTION OF NEW PROCESSES OFTEN MEANS MONTHS OF RESEARCH AND EXPERIMENTATION

A Romantic Achievement in Industrial Chemistry

A Paint Which May Be Applied Quickly, Will Dry Rapidly, Is Tough, Hard and Resistant to the Elements

TODAY nearly three million automobiles are finished with a substance which is neither paint, varnish nor enamel, but which combines and enhances the qualities of them all. Millions of dollars worth of fine furniture, private railway cars, day coaches, pianos and even tank cars have a similar finish. Up to six months ago it could only be applied by pneumatic spray guns. Today it can be brushed on in the home. Unlike the finishes which have been standard for generations it is not made from gums and oils with a turpentine thinner. It is a new development of nitro-cellulose with butyl alcohol, distilled from grain, as a solvent.

A Task for Pioneers

St. Gaudens said that a sculptor was a man who mixed brains with clay. The corps of chemists who created this finish were pioneers. They mixed years of painstaking research and experience with cotton-nitrates, solvents and pigments. They modified every ingredient and in some cases they actually synthesized wholly new compounds to serve as ingredients. Then they purified, perfected and amalgamated all of the ingredients into a finished product.

Today, the substance which they created is used around the world. This, in brief, is one of the latest romances of industrial chemistry.

A "paint" was wanted that would have all the advantages of the old varieties, with none of the disadvantages. It must be compounded so that it could be put on quickly, so that it would dry rapidly, but so that it would stay permanently, and wear indefinitely without loss of lustre or protecting power. And there were, apparently, no beaten paths to follow—no products that might merely be improved.

Dr. Charles M. A. Stine, Chemical Director of E. I. duPont de Nemours and Company in Wilmington, Delaware, under whose direction it was developed, thus describes the inception and production of this most important commodity.

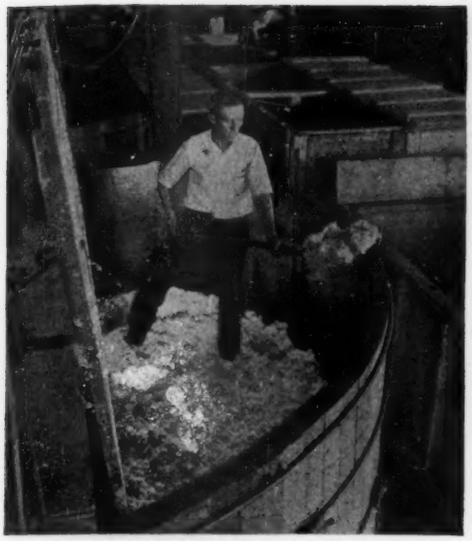
"In effect, we were told that what was wanted was a finish that would protect cars, furniture, and other finely finished objects. The paint, or lacquer, or enamel, or what-not, that we were to develop must be as handsome when it was applied as is the finest finish ordinarily used. Yet it must be capable of much more rapid application. It must be capable of carrying color pigments or other coloring matter, so that various shades might be readily obtainable, and these colors must not fade. When dry, the desired product must be hard, so that it would not scratch, must—in this particular—be similar to glass. Yet it must not have the other properties of glass, lest it crack too easily. Therefore, with its hardness, it must be tough. Furthermore, it must be proof against the action of water, against oil, against grease, and against the action of such acids as might come in contact with it. It must not deteriorate under the action of heat or cold. Ice and snow, sunlight, dust, sandstorms, or mud, must leave, if possible, no mark at all. And of course, the product must be able to compete in price with the finishing compounds in ordinary use.

ACCURACY OF DETAIL
Is essential where reactions depend on precise formulas

Requirements Were Stringent

"What this new finish was to be made of, no one cared. But of certain things we were sure. It must be made of such mixtures as would not eat their way through tin cans, for example, for tin containers would be necessary for its shipment and storage, and the paint would be worse than useless if it ate through the tins and trickled all over the shelves. Neither must it undergo any chemical changes after it was prepared, for that might change the final result. Then, too, it must have good 'covering power.' That is, it must not be transparent, except when used as a varnish, for part of its job is to hide the color and texture of the material over which it is to be spread. And there were many other qualities that it must or must not have. And with these specifications we set to work."

The development of this new finish began with nitro-cellulose. When nitrated cotton is dissolved in amyl acetate and put on a surface it dries very quickly. It is commonly used as a coating to protect lighting fixtures, fine hardware and silverware from tarnishing. But so thin is this protecting film, when the solvents evaporate, that despite the fact that it is very hard and very tough, it has not the



PLACED IN NITRATING TANKS

The clean linters receive the first process step

"body" to stand up under hard usage or to wear well.

This lacquer had many of the properties which the chemists were seeking. Could the chemists make a similar solution containing several times as much nitrated cotton, and thus make a film several times as thick when the solvent has evaporated? This was one of the many problems.

Chemists tried that, but it did not work. They put in more nitrated cotton, but immediately the solution became more or less jelly-like, and there was no way to spread it out smoothly. Formerly it was thin enough to use, but it left too thin a coat. Now it would leave a thick coat, but it was too thick to spread.

For a long time the experiments seemed to stand still, or at best to progress very slowly; and then an accident occurred, which provided the romance which sometimes relieves the patient drudgery of a chemist's life.

An Accident Leads to a Discovery

A new batch of this thick stuff had been assembled and was in a large container ready to go to the mixing machine. It was summer-time. The laboratory was warm and, as a matter of experiment, some caustic soda had been put into the mixture. But just as the jelly was about to be put into the mixer, the machine broke down. It was difficult to repair it, and the container with the compound stood idly by for several days while repairs were under way. Finally, when the mixer was in working order again, the container was wheeled out, the lid was taken off, and to the amazement of everyone the jelly-like mass had become almost as thin as water, and almost as clear. Here it was, apparently—the very stuff for which the chemists had been looking for several years.

Why it was thin the chemists did not know, but after all, the *why* was less important than the *how*. So they investigated, and found that apparently certain chemicals, together with the summer temperature and the waiting, had rearranged the molecules somehow or other, and had thus changed the consistency of the mixture.

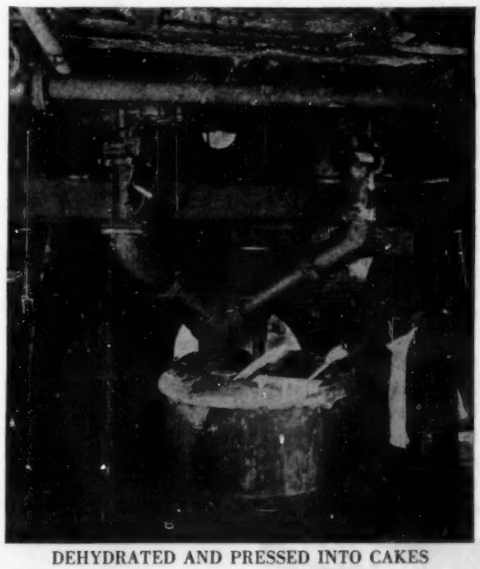
The next test was to see if it worked; and after much experimenting it was found that while it could be spread, while it dried very rapidly, and left a heavy film, it was impossible to use it satisfactorily with a brush, for when it dried, the brush marks were plainly to be seen. Further experiment, however, proved that with a spray gun it could be applied perfectly.

But here another problem presented itself.

Everyone knows that when there is rapid evaporation, there is a decrease in temperature. But where there is a rapid lowering of the temperature, there is often a condensation of the moisture in the air. So, when this mixture was applied, it dried so quickly as to lower the temperature of the surface on which it was spread, and that, in turn, sometimes caused the moisture in the air to condense, with the result that the water often discolored the coating of "paint."

So the mixture had to be prepared in such a way that while it would dry quickly by the evaporation of the solvents and would deposit the desired clear film very rapidly, the moisture which might condense on the chilled surfaces, especially in the summertime when the humidity is very high, must not damage the finish by producing an opaque, milky appearance of the freshly painted surface—"flushing" as it is called.

It was found that this hazy, milky appearance of the surface, was due to the dilution of the solvents in the mixture by the water condensing out of the air and mixing with these solvents. This difficulty was overcome by slowing up the evaporation of the volatile constituents of the paint as well as by increasing the solvent power of certain of the ingredients used, so that the addition of small amounts of moisture would not affect the appearance of the finished film.

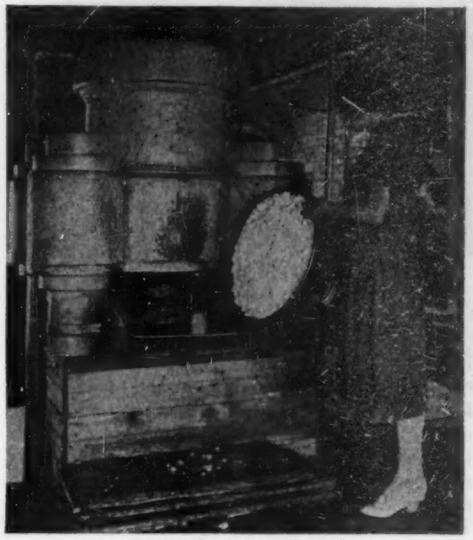


DEHYDRATED AND PRESSED INTO CAKES

The nitrated cotton is relieved from the bottom of the press

"With that accomplished, the new compound was a long step on its way to perfection," Dr. Stine explained. "When applied, it became hard and very tough. It was not affected by ordinary acids or alkalis, such as road tar and certain types of dust and mud which contain lime or sodium salts. In the West there is enough alkali (sodium carbonate and carbonate of lime) in the dust to actually injure a finish not properly compounded. But it was necessary to find out just how hard and tough and resistant it was. Furthermore, it had to be colored, and the colors had to be carefully chosen. The pigments must not settle so as to make it hard to mix them thoroughly when the compound was to be used. And, of course, the pigments must not fade."

This necessitated a lot of experiments and tests. And the tests necessitated the development of a lot of strange contrivances. To find out if the finish would fade, panels of wood and metal were painted with it and were put on the roof. But that was not satisfactory, for they would have to remain there for a couple of years before the tests would be conclusive. Already several years had been spent on the task, and no one was in the mood to sit and wait for a few samples to fade on the roof. So an apparatus was designed wherein samples were arranged around an ultra-violet light and automatically immersed in containers of water where they were soaked for definite periods, then exposed again to the eye of the ultra-violet arc so that the heat and light played on the wet surface. This was so powerful that in a week or two the normal effect of two years in the sun was obtained.



CLEAN COTTON LINTERS

Being placed in the top of a powerful press

In this light, the first painted panels exposed not only faded, but when examined under a microscope, exhibited certain incipient cracking which was considered as indicating ultimate failure.

In fact, a regular part of this test is to examine with a microscope the panels which have been exposed to the artificial sunlight and the artificial rain storms, in order that the incipient failure may be detected long before it becomes visible to the naked eye. Many finishes are said to have "failed" when, to the unaided eye, they still appear smooth, unbroken films; but the searching eye of the microscope reveals the beginning of the formation of minute cracks and crannies between the grains of the film which, perhaps, months later might develop into actual failure of the finish.

NITRATED COTTON LINTERS

Are treated by several processes until assimilated

TESTING THE PAINT

In a violet-ray, automatic weather-producing machine

These initial failures were a serious disappointment, but they served merely to emphasize the value of the accelerated weathering test and to set for the laboratory the task of learning how to avoid this incipient failure. In some cases, the difficulty was due to the pigments employed. They were not properly compounded. Back the chemists went, to work on the pigments, and they produced a whole new set. This time the ultra-violet light and the artificial rainstorms had no effect whatever. The color remained the same and the film was durable. The tests prove only that at the end of a year, an automobile finished in this new composition is likely to present a better appearance, so far as the finish is concerned, than it presented when it was new.

But there were other things to find out about it. It was hard, of course, but just *how* hard? At first they tried to scratch it with their thumb nails. Then they rigged up a machine to cut it with a sharp blade, measuring the pressure required. But the incision tended to close after the blade was lifted out, and so the results obtained were not accurate. And so the experimenters developed a different kind of apparatus.

A balanced scale was made. On one of the arms was a perpendicular column, on top of which a ball-bearing was placed. On the other arm a platform was built to hold weights. Now samples of the clear, uncolored enamel are spread on glass and allowed to dry. These samples are turned upside down, and placed on a support over the ball-bearing. A weight is placed on the other end of the scale, pushing the ball-bearing up against the enamel. The diameter of the dent made by the ball in the film is measured with a microscope and the hardness of the film can be measured by the weight necessary to make the dent a certain diameter. Another test uses steel plates finished with this paint, which are chilled and then dented on the reverse side. This finish must survive blows which may crack the steel but not the finish!

But how tough is it? And how can toughness be measured?

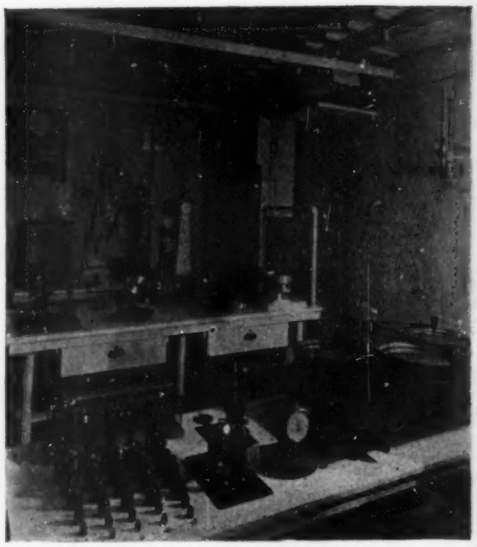
Durability Tests by Special Machine

Coats of the film are spread on sheets of tin. When the mixture has dried it is peeled off the tin, and a stamping machine cuts pieces from the strips. These pieces are all cut the same size so that the results may be compared. Clamps take hold of the ends of this thin film, and tension is put on them. The amount of force necessary to break the film is measured, and the experimenter learns how tough the film is. This same apparatus is used to measure resiliency. How far can the film be stretched, in other words, and how much will it tend to resume its former shape?

It is obvious to anyone that the material dries quickly. But how quickly?

At first, a coat was spread and someone stood by with a watch and touched the sticky surface from time to time, until his finger no longer made a mark. But now a disk of glass is painted, and is instantly put on a revolving plate. Over this is a sand box, from which pours a fine stream of sand. The sticky disc revolves, and the sand is directed on it in a spiral. By a simple timing device the time of the revolutions is noted, and after the film has dried, the glass disc is taken out and shaken. The sand that has fallen on the film after it has dried flies off, and a gradually fading spiral of sand shows how long the drying process took.

It takes 13½ hours to paint the body of one make of automobile with this new finish. Formerly it took 336 hours with ordinary varnishes and enamels. The labor costs less, and the costs for materials have been decreased as well. Because of the increased speed in handling cars in the automobile paint shop, the number of bodies tied up in the process and the space necessary for them have been reduced 75 per-



CONSTANT TEMPERATURE ROOM

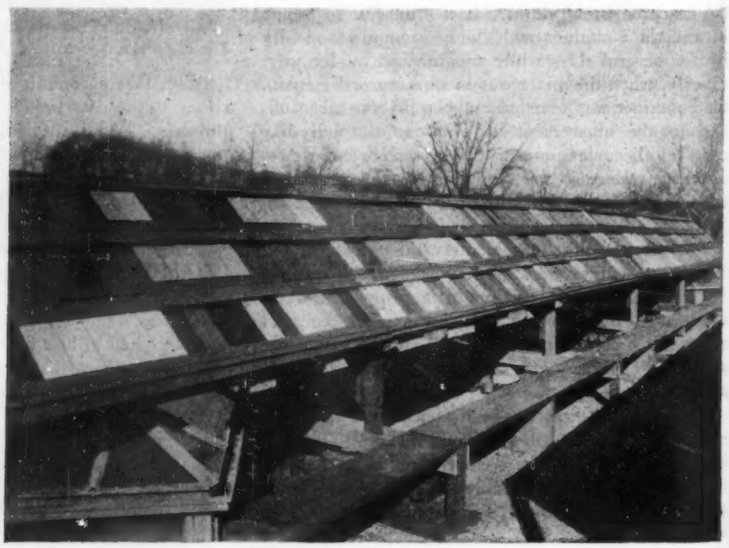
Where tests are made for toughness and durability

cent. Through the saving thus brought about, one big manufacturer of medium-priced cars was enabled, recently, to reduce considerably the price of his product.

The success of this new finish, which was rapidly adopted by the automotive, furniture and railroad industries, created a public demand for a product which could be used in the home. Few of us have enough work to do in painting the kitchen chairs or the baby's hobby-horse to warrant putting in a spray gun and an air compressor! Consequently, work was begun on perfecting a "brushing" product similar, in its final effect, to the spray-gun product. It took two years to do it, but it is done—done too, after many unsuccessful experiments that finally set Dr. Stine and all his assistants to work, toward the end of 1925, with their sleeves rolled up and their coats off—working evenings and Saturdays, holidays and Sundays—for four energetic weeks. At the end of that time, they rolled down their sleeves again, and emerged from the laboratory with a new finish and laconically announced that here was a finish which had passed the chemical tests but would have to be tested in actual use. Then this was done; successfully, too. Truly romance lurks even amid the exactness of the chemical laboratory, if we can but find it.

SPRAYING PAINT ON A RAILROAD CAR

In the railroad service the practical utility of this paint has been fully proven



TESTED BY RAIN AND SUN

The finished product is tested under service conditions for permanent pigmentation

HOW THE COLOR IS MEASURED

LEFT: *The container with the hay is attached to the apparatus.* CENTER: *Adjusting the color disks on the shaft.* RIGHT: *The hay and color disks are revolved after matching*

Measuring the Color of Hay

Definite Standards of Color Have Been Formulated for Use in Grading Hay

By O. M. Kile

"COLOR sells hay," is a common expression among hay dealers. What they mean is that hay which retains its natural green color usually has more feeding value and brings a better price than other hay.

But how to determine color accurately was a troublesome problem to hay experts of the United States Department of Agriculture, who were seeking to set up standards by which hay might be graded. "Light green" or "medium green" are expressions which may mean entirely different things to purchasers or even to official inspectors of hay.

By an ingenious application of the Munsell Color System, worked out by K. B. Seeds and his associates in the Department of Agriculture, local inspectors may now determine color values accurately and definite color standards have been set up.

Hay of Composite Color

For applying the Munsell system to practical use, disks are provided whose color values according to the Munsell system are known, and which include the five primary colors, red, yellow, green, blue, and purple, and five intermediate colors, yellow-red, green-yellow, blue-green, purple-blue, and red-purple. When two or more of these disks are spun on a motor shaft at high speed, the colors of the exposed portions blend into one composite color. By trial and error in the selection of the various disks and changes in the amounts displayed, any color can be matched. The measurements for this color according to the Munsell system can then be calculated from measurements of the exposed areas of the various standard disks used in making the match.

Hay does not have a solid color but is composed of many plants having wide color variations. These various colors must be blended into one composite color before the color of the hay can be measured by the Munsell system. To obtain this composite color a machine was devised in which a portion of the hay is spun at high speed. The Munsell disks are spun simultaneously on the shaft of the apparatus. Thus the composite color of the hay may be compared with the composite color of the disks.

This machine and the methods employed in its use are shown in the illustrations. When it is desired to measure the color of the hay in a bale, the bale is opened, portions spread on a table, and a representative portion selected from the lot by trained investigators of the Department. This wad of hay is then placed in the metal container, the circular wooden cover is placed over it and the container and cover locked together with thumb screws in such a manner that the wire screen in the center of the circular wooden cover presses tightly on the outer surface of the hay to prevent loss of leaves. This container is then fastened to the front of the machine with the shaft through the center of the hay. The operator next selects the disks which he believes will produce a composite color matching the hay and arranges them on the threaded end of the shaft in the center of the hay.

THE WIRE SCREEN

In the center of the circular wooden cover, a wire screen presses tightly on the hay to prevent loss of leaves

Used in Grading Hay

The disks and hay sample are then rotated at a speed of about 1,200 revolutions per minute. The illustrations show how the various colors of the hay and of the disks blend into concentric rings of composite color at this speed. The operator notes the relative composite color of the disks and the hay. The apparatus is stopped and if a perfect match is not obtained at the first trial the disks are readjusted to display such different amounts of the various colors as seem most likely from previous experience to bring about a perfect match. This process is continued until by trial and error the perfect match is obtained. The operator then measures the size of the segment displayed of each disk used in matching the hay. From the figures thus obtained the hue of the hay according to the Munsell Color System is easily calculated by means of a definite formula.

Samples from hundreds of bales of each kind of hay have been measured in this way by specialists of the Department. As a result of these color investigations it has been possible to formulate definite standards of color for use as a grading factor in the standardization of the most important kinds of hay.

This device for measuring the color of hay may be used for measuring the color of other commodities with certain modifications to adapt it to their varying physical requirements.

MULE POWER IS USED FOR TRAM CARS TO GET BANANAS FROM THE PLANTATIONS TO THE MAIN LINE OF THE RAILROAD

Agriculture in the Tropics

In Actual Production of Food Value per Acre of Land Cultivated, the Banana Exceeds Wheat or Any Other Crop

"POPULATION has a tendency to increase faster than food," wrote Thomas Robert Malthus when the United States had a population of almost five million.

Now that we have an estimated population of 120,000,000, the struggle for existence is far more real than it was in 1800, when the thinking men of the world had begun to appreciate the truths stated in the Malthusian theory.

There is, however, one saving grace in the situation—and that is the increased facilities for transportation by railways and steamships which make it possible to transport food quickly from one part of the world to another. If we except those remote districts of Asia where modern transportation methods are unknown, it is impossible for starvation to occur today; for in the event of disaster, radio and telegraph would carry the news far and wide, when swift steamships and railways would unload supplies almost before the victims of fire, quake or failing crops would be more than unpleasantly hungry.

A Staple Food in the Tropics

But in order to have necessities, it is first necessary to produce them; and the most important quest in the world today is that for virgin territory where additional commodities may be raised in order that the mounting millions of the world's population may be cared for.

Our own west, the steppes of far-away Russia, the llanos of the Argentine, the fertile spots of Africa are on the way to contributing their quota. Still the cry is for more arable land. Where shall it be found?

There remains no "terra incognita." Practically every foot of the land surface of the habitable globe has been accounted for and information regarding water supply, fertility and nearness to markets is all set forth.

A possible solution of the problem lies in a more extensive use of the vast territory included in the equatorial region—the most fertile, the most prolific land in the world. An abundant rainfall, the solar warmth that nature loves, and a soil fertilized by the vegetable mulch accumulated through countless years, make it the favored spot for raising bumper crops.

An appreciable start in tropical agricultural development has already been made. Last year there were imported into the United States 28,225,556 stems of bananas—1,328,688,267 pounds of this delicious tropical fruit which is as sustaining a food as the familiar potato, and which reaches the ultimate consumer in a wonderful germ-proof package designed by nature herself. In addition to the number of pounds brought into the United States, an enormous quantity of this fruit was imported into Europe where, year by year, bananas are becoming more popular.

CUTTING INTO A BANANA PLANT
Note the exceedingly porous character of the wood

The banana is not a luxury. It is a staple food. Together with its near relative, the plantain—*musa paradisiaca*—it constitutes the chief source of carbohydrate food of enormous numbers of people dwelling in tropical countries; and it occupies in their dietary the place taken by potatoes and such cereals as wheat, rye and barley in the rations of dwellers in the temperate zone.

Rich in Food Value

Estimates by various authorities show that in actual production of food value per acre of land cultivated, the banana exceeds wheat or any other crop. For this reason, the banana affords a valuable addition to the standard food supply and its greater utilization will help to solve the economic problem of how to supply the world's increasing millions with a staple food which is obtainable at all seasons and at a reasonable cost.

In addition to its carbohydrate content, the banana also contains other essential food elements, namely, mineral salts and vitamins and, in small quantity, protein and fats. In flavor as well as in food value it easily heads the list of fresh fruits. In energy value and tissue-building elements it surpasses most vegetables. Judged by these standards, the banana costs less per pound at all seasons than any of the

other fruits and most of the common vegetables.

The low-lying country bordering the Caribbean Sea and along those rivers which flow into it, is the natural habitat of the banana; and it is this land—which was largely primeval jungle—that is now being made to yield its share of the world's food supply.

The first and most important step in the establishment of a banana plantation is the selection of the land. Climate, soil, rainfall, drainage, liability of damage by flood and hurricane, as well as by insect and animal pests, must all be considered. Then there is the problem of establishing and maintaining adequate transportation facilities.

For the plantations, virgin land is used. Usually this land is heavily forested and covered with a dense tropical undergrowth as well. Once the necessary drainage system is completed, the land must be underbrushed, lined and staked before it is ready for planting.

Each Plantation a Village

"Underbrushing" consists of chopping out the heavy secondary growth with machetes, so that the workers may move about easily between the trees. The lining and staking operation consists of plotting out the desired locations for the individual plants and marking each location with a small stick of bamboo or wild cane as a guide for the men who do the planting.

The small "marker" is usually a piece of rhizome or bulbroot, planted in the same way that flower bulbs are planted in a northern garden. The seed bulbs—each of which weighs several pounds—are dug on adjacent banana plantations and carried to the new development on the backs of pack animals.

Next comes the felling of the larger trees, which, to prevent injury to the young plants, must be done before they appear above ground. Owing to the density of tropical growth and the enormous size of many of the trees, this process is both laborious and costly.

To the uninitiated, a newly established banana plantation, after the felling has been done, would seem a land laid waste by some devastating force rather than a "farm" in the making; for the entire plantation is an almost impassable tangle of stumps and trees with branches interlocked and matted with vines, like a heavy forest shorn off at the ground and laid flat in a tangled mass.

Through this mass must be cut the right of way for small narrow-gage tramways and roads. Without this transportation system, the materials necessary for construction work and the supplies for employees and laborers could not be brought from the supply base which may be, and frequently is, many miles away; nor could the bananas themselves ever reach their waiting markets. Quarters for employees and laborers have to be built, areas cleaned and pastures made for work animals. In short, a small, complete, modern village must be built and maintained on each plantation.

A PERFECT BUNCH OF BANANAS

The banana grows with the individual fruit pointing upward and not downward as they are hung in the fruiterer's shop

Much of this work must be done simultaneously with or immediately after the planting in order to be ready to handle the crop which begins to come in twelve months later.

It is a race against time—a race in which the uncertainty of the elements plays an important part. Both farm and construction work are continually interrupted by heavy rainfall. The most promising outlook may be turned into disaster over night by a flood and several months' time and labor lost. On the other hand, should there be a drought, many of the seed bulbs may not germinate, necessitating later replanting. Also, a fire may start among the felled timber. Either occurrence is disastrous to the planting.

At the end of three months, the plantation is given its first cleaning by hacking away the branches of the felled timber and chopping down the rank tropical growth which has sprung up since the seeds were set and which, if left, would soon choke out the young banana plants.

Regularly thereafter, at intervals of three or four months, this cleaning is repeated and each time "misses," which have resulted from failure of the seed bulb to germinate or from damage to young plants by felling or other causes, have to be replaced by replanting. The success of the plantation, however, depends largely upon the "stand" of healthy plants obtained from the original planting.

Each plantation is in constant touch by telephone with its district headquarters and the central office, which issues cutting orders to insure the fruit reaching port at the same time as does the steamer which is to carry it to market.

No Slack Times Here

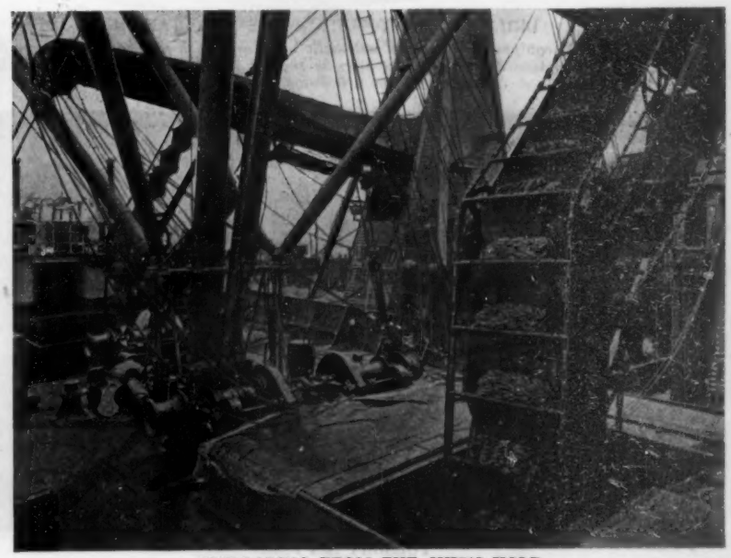
The northern farmer generally ships by truck to the nearest railroad. Frequently his truck delivers his produce direct to the market. Beyond paying his share of the road tax, he is not concerned with "maintenance of way." In the tropics, however, each "farmer" is responsible for the maintenance of a fairly complicated transportation system. Throughout the year, he must keep a considerable force of men at work clearing the swift-growing vegetation from the rail and tram rights of way, and from the roads by which men and pack animals bring the fruit to these carriers. There are innumerable bridges over the drainage and irrigation ditches and the small creeks. These require constant attention and repair, particularly after heavy rains, when many of them are swept away by the rushing waters.

On these tropical "farms," the slack times on which northern farmers can count are practically unknown. From the time the new land is selected until the last bunch of fruit is shipped, the race against time is unceasing.

Without a doubt, the next decade will see vast development in tropical agriculture for various essentials—rubber and food products particularly. In this reclamation, the United Fruit Company stands as one of the pioneers in its accomplishments as to production and—possibly an even more important phase—the development of health and hygiene to a point comparable with that in temperate zones. It is indeed a task for the indomitable—for men who never for a moment concede that the thing they set out to do is impossible of achievement.

TRANSPORTATION ON THE PLANTATION

Bananas from distant plantations are loaded on donkeys for transportation to the railway



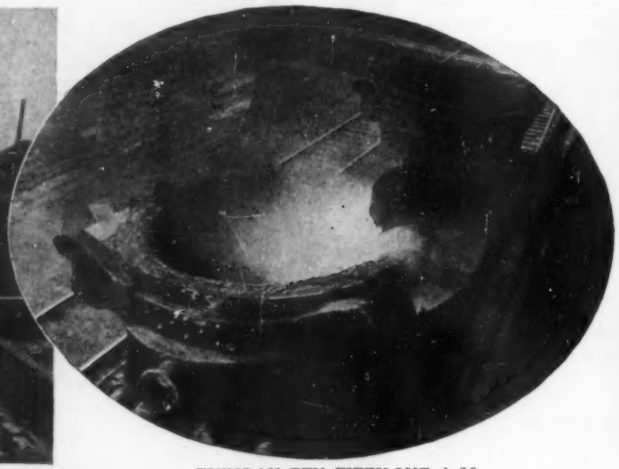
UNLOADING FROM THE SHIP'S HOLD

Each pocket of a moving endless belt carries a single bunch of bananas to its destination

Forty-one Hours From Raw Materials to the Finished Au

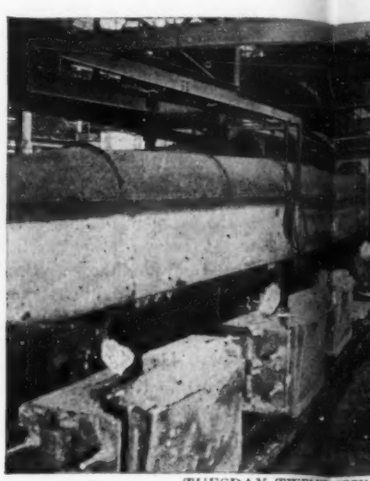
MONDAY SEVEN P. M.

It is the control of primary necessities that enables Ford cars to be produced economically. Iron ore is brought to the Fordson works in the company's own ships. Here it is unloaded mechanically and the great production cycle begins, to end forty-one hours later



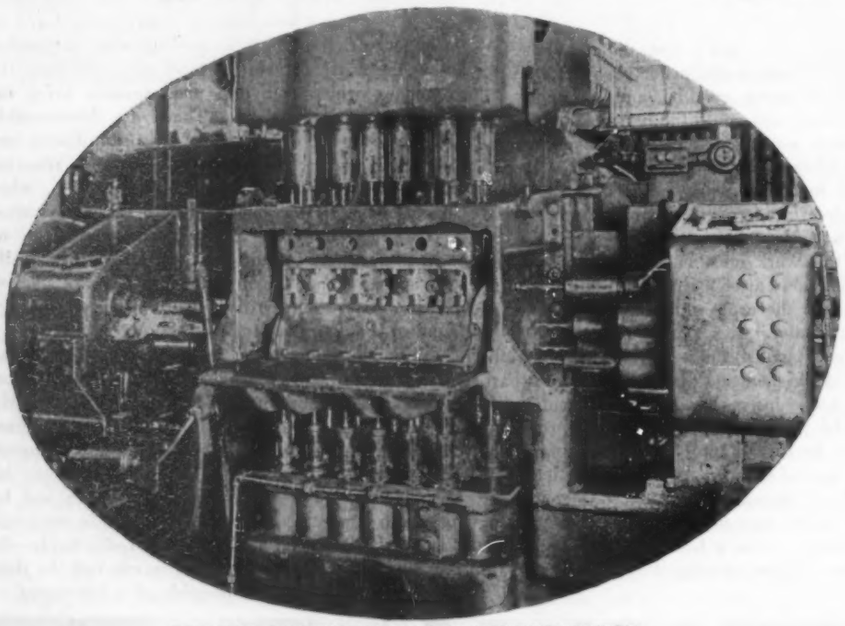
TUESDAY TEN FIFTY-ONE A. M.

Sixteen hours later, the ore has been reduced to foundry iron. It is then cast into pigs and sent to the foundry, where it is remelted with scrap. This takes four hours in all. Blast furnace metal is also cast direct. All required castings are made in Ford factories



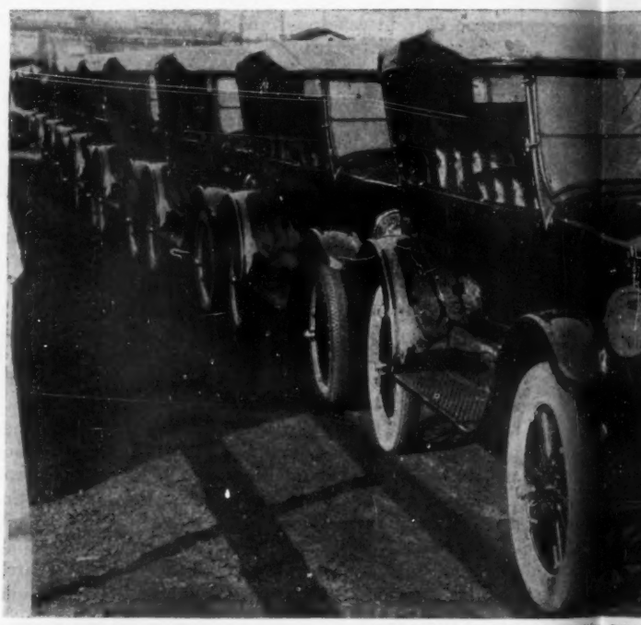
TUESDAY TWELVE FIFTY-

As the conveyor brings the molds past the pouring cylinder blocks. These go to the "shakeout" statio cooled and cleaned—both processes requiring severa ready for the necessary m



DRILLING FORTY-EIGHT HOLES SIMULTANEOUSLY

The Ford plants are equipped with special automatic machines which save vast sums every day. Here is an example, for this machine drills forty-eight holes in the cylinder block at one time. Machines which are almost human are found in all departments

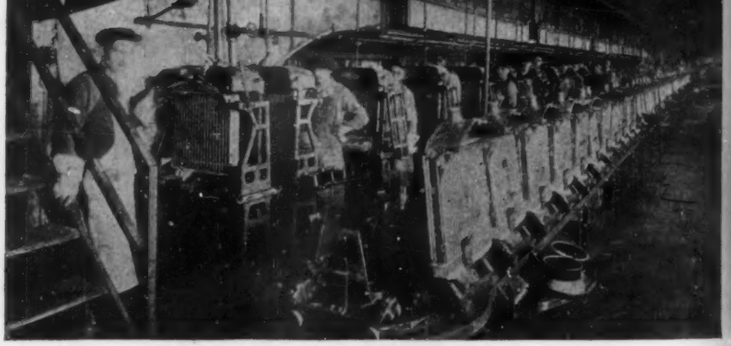


WEDNESDAY TWELVE NOON—REA

Only forty-one hours have elapsed from the time when the ore arrived until the car is d possible by an enormously efficient plant and the control of raw material. This syst popularity of the finished

TUESDAY SIX P. M.

About six o'clock, the motor block is ready for the assembly line. It requires about ninety-seven minutes for assembly. Nearly every operation is done "on the move"



NINE TONS OF SOLDER DAILY

Few automobile manufacturers make their own radiators, but over nine thousand a day are made at Highland Park. The illustration shows the radiators ready to be soldered

Assem

ed Automobile—Through Systematic Production Methods

Y TWELVE FIFTY-FIVE P. M.

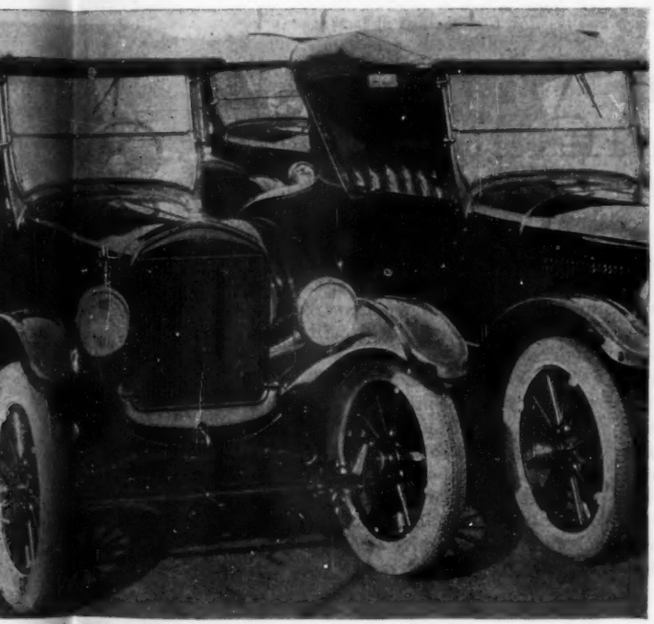
lds past the pouring station, the hot metal is cast in he "shake-out" station and are then taken away to be sses requiring several hours. These castings are then for the necessary machining

FORGING IS PROCEEDING SIMULTANEOUSLY

One hundred and sixty-two steel forgings are used in Ford cars and trucks. The Highland Park, Michigan, plant has the largest forging shop in the world. This steam hammer ram has a falling weight of five thousand pounds

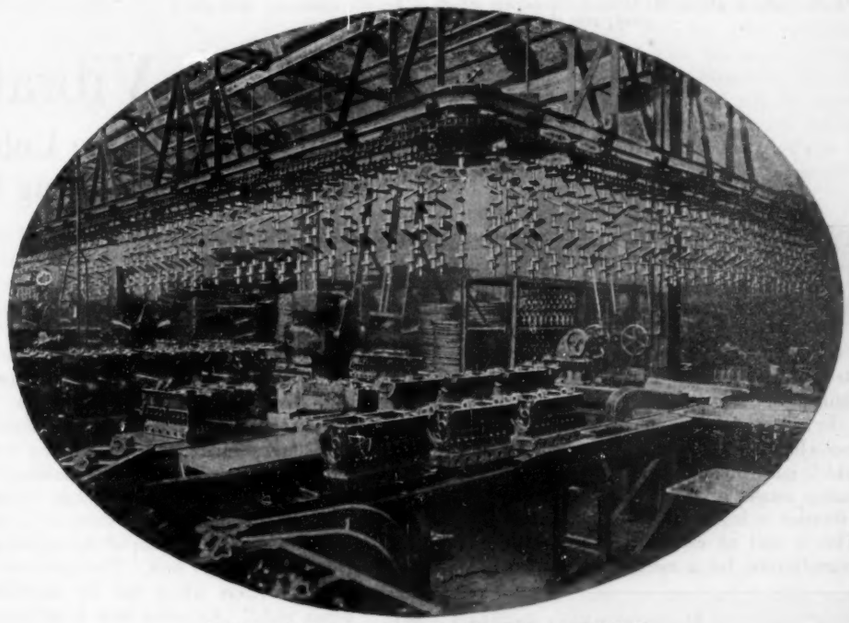
TUESDAY FIVE FIVE P. M.

The casting now goes to its first machining operation. There are fifty-eight operations in all which are finished in approximately fifty-five minutes. All these operations are performed in the foundry building itself to save time and handling and so reduce costs



ELVE NOON—READY TO DRIVE OFF

ed until they are driven off. Here is the secret of Ford profits—a quick turnover made material. This system and the standardization of parts accounts for the low cost and rity of the finished product



HOW THE PARTS ARE CARRIED FOR ASSEMBLY

The parts are being brought together for assembly. Mechanical conveyors are used throughout the plant. Nothing is handled by hand if it can be avoided. Special mechanics are always on hand to repair any breaks in the conveyors

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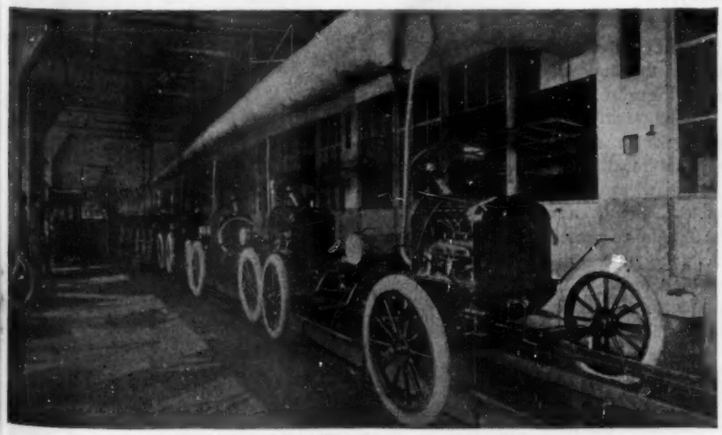
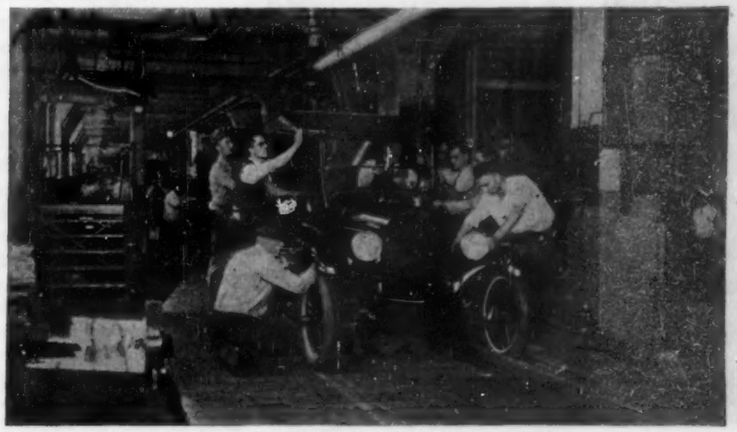


FINAL TEST TAKES CARE OF EXHAUST

Assembling of cars is done at the main plant and at various branches. The illustration shows the chassis on the assembly line, the motor exhausting into a suction chamber



WEDNESDAY EIGHT A. M.

The assembly lines pull the chassis a few feet and then stop, enabling the mechanics to do their bit on each car. This idea is now used in assembling other cars

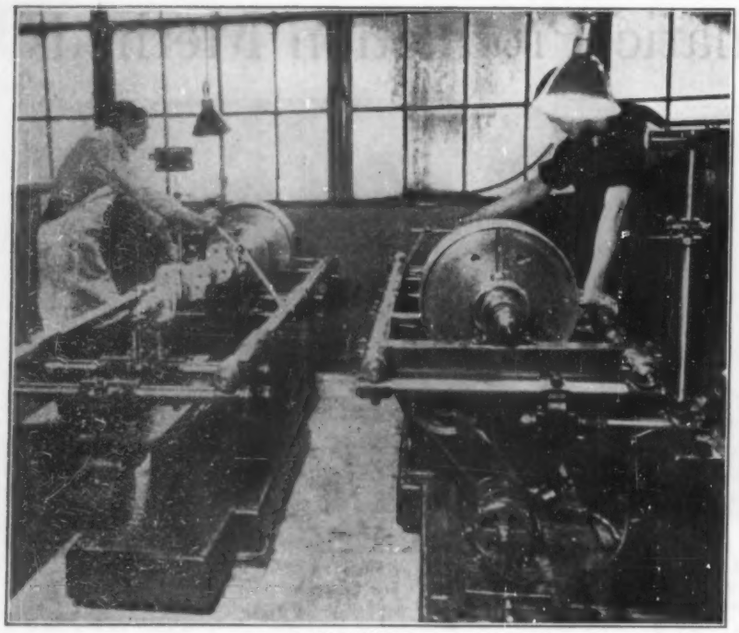


FIGURE 1

On the right is shown the driving mechanism which is flexibly connected with the test piece; also the disk K with radial slot

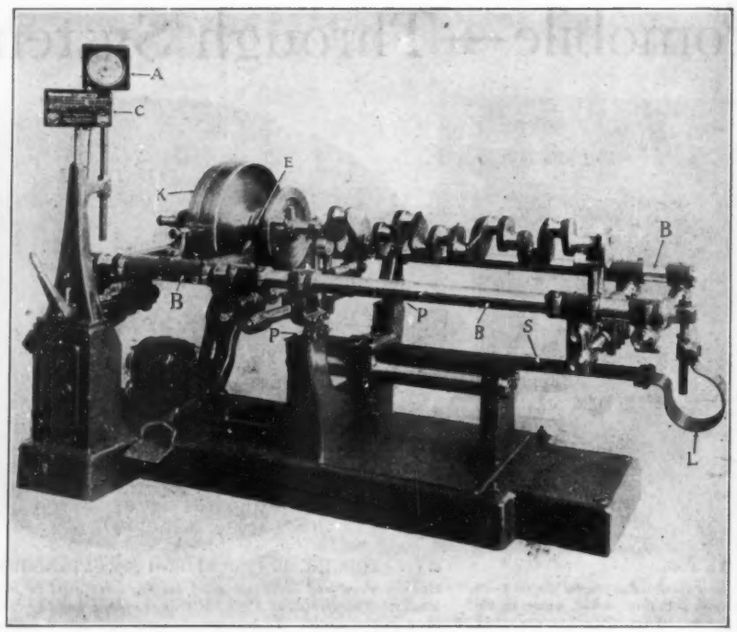


FIGURE 2

Balanced on knife edges, the test frame is free to oscillate, limited only by the control spring S and the link L at the end of the frame

Killing Vibration

An Exact, Scientific Method by which Minute Unbalanced Masses in Rotating Parts of Machinery are Being Located

IN the history of mechanical engineering, no advance in efficiency within an equal period, has been recorded, approaching that of automotive engineering during the last twenty-five years. From the single cylinder of the early days to the present straight-line eight, an astonishing record of one refinement after another is evidenced.

In his articles on Engine Balance*, Professor Cormac clearly outlined the fundamental considerations which must obtain, in order to balance the reciprocating masses of the moving parts and to eliminate vibration in high-speed, internal combustion engines. This is still an essential procedure preliminary to manufacture, but a method has now been perfected which adds the further refinement of locating the unbalanced masses in the finished product itself, both as to their total moment and their plane of location. This is accomplished by a particularly ingenious and interesting mechanism called the Gisholt precision balancing machine, which is being widely used by manufacturers for balancing crankshafts, flywheels and other rotor parts.

In a rotating shaft, a state of unbalance is caused by unequal centrifugal forces pulling from the axis in different directions. In determining the amount of metal to remove, or the weight to add in order to correct the unbalanced state, it is necessary to measure the exact amount of the unbalance in terms of some convenient unit. The unit used in the balancing machine which we are describing, is the "ounce inch." An ounce inch is the relative centrifugal force produced by a weight of one ounce at a distance of one inch from the axis.

Dynamic Balance Analyzed

Dynamic balance in a rotating object is always secured by counter-balancing in two different transverse planes, located preferably near the ends of that object. For example: the drum, Figure 6, may have a heavy spot in its wall at H, the position of which is unknown. In balancing this drum, no attempt need be made to find the exact location of this heavy spot, but two planes c and d, are arbitrarily selected in which the weights C and D may be placed in order to counteract the unbalance caused by the heavy spots. Dynamic balance places the body so that when rotating at speed, it tends to lie freely in a perfectly horizontal plane, or to remain without vibration in whatever plane the center line of its bearings prescribe.

If the heavy spot H, happens to be nearer to the correction plane c, than to the correction plane d, then, in order to secure dynamic balance, the two weights C and D, must be of different sizes. The sum of the two weights, will, of course, equal the weight of H, but the heavier one must be placed in the plane c, shown in the figure. The lighter weight must be placed in the plane d, farthest from H. Such corrections would place the drum in complete static and dynamic balance.

In the illustration, Figure 2, the various important parts of a precision balancing machine are indicated. B is the pivoted frame on which are mounted the headstock E, and two adjustable roller bearings for supporting the shaft to be tested. This frame rests on two "knife-edge" pivots P, which are located a substantial distance apart in a transverse plane in order to give stability to the frame. This frame, with its pivot bearings, is flexibly held in a

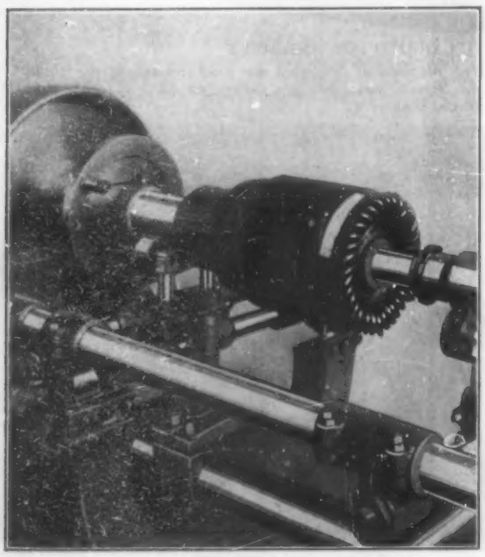


FIGURE 3

One of the important applications of precision balancing is to high speed electrical rotor parts

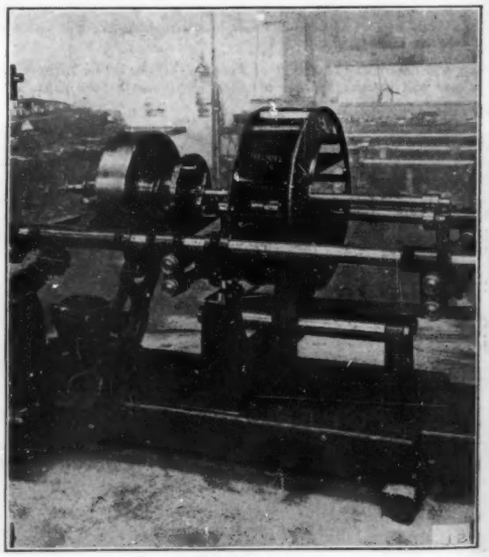


FIGURE 4

Important improvement in the efficiency of fans has been obtained by correct balance

*Scientific American, Vol. 133, Pages 33-34 and 133-134 (July and August, 1925).

horizontal position by means of the long, flat spring S, which is fastened rigidly at one end to the heavy base of the machine, the other end being attached to the outer end of the pivoted frame by means of the spring L.

The headstock E, carries a spindle which is provided with a suitable clutch for making a positive but flexible driving connection with the shaft to be tested. There is mounted the large disk K. This disk is provided with a radial slot in which slides a counterweight W, which may be clamped in any location in the slide from the center to the edge of the disk. See Figures 1 and 2. Along the slot there is a graduated scale in inches and decimal fractions thereof. This has its zero mark at the center, and bears an index mark cooperating with this scale. The standardized counterweight is 10 ounces, and by means of this, the disk K, may be thrown out of balance by any desired amount, measured in ounce-inch units.

Counterbalancing the Unbalance

When the counterweight is at the zero mark on the scale, the spindle with its clutch and disk mounted on it is in a state of perfect balance. The frame, loaded with its headstock and the piece which is about to be tested, is free to swing on the knife-edge pivots like a scale beam. Due to its weight, it has considerable inertia. This inertia is counteracted by the heavy spring S. Therefore with the shaft and spindle at rest (not rotating) the frame, when given an impulse, will oscillate up and down with regular beats, the time of which is constant and independent of the amplitude of the swing. These beats are recorded through suitable links on the indicator A. The length of time for a complete oscillation is called the "natural period" of the frame.

When the object which is being tested rotates at a speed such that the time for one revolution exactly equals the natural period of the frame, it is said to be rotating at the "critical speed." In operating the machine, the critical speed is obtained by starting the shaft at a speed slightly too high, and then, as it continues to rotate by its inertia, letting it gradually slow down to the critical speed, at which the number of revolutions and oscillations exactly coincide.

On account of the existing unbalance above noted, its rotation will obviously cause the frame to oscillate on the pivots. By watching the pointer move on the indicator A, as the piece continues to rotate, the amplitude will be observed to increase slowly as the speed of rotation slowly decreases. When the critical speed is closely approached, the amplitude will begin to increase at a more rapid rate, and when

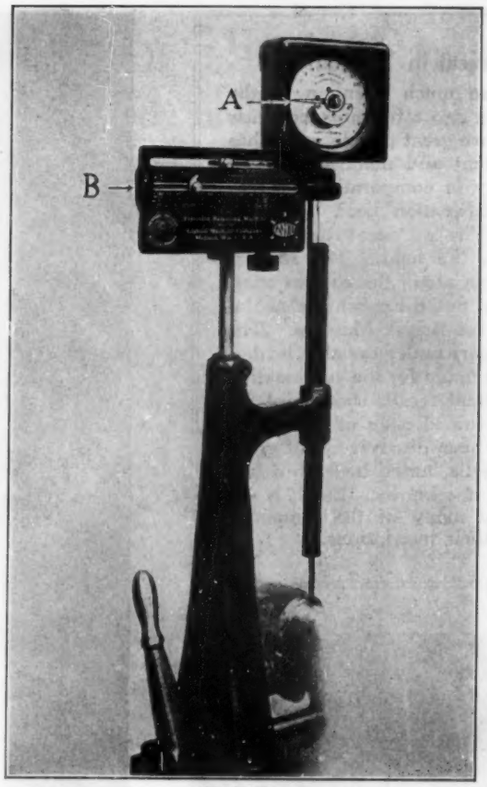


FIGURE 5

Above, "A" registers the beat or oscillation of the balanced frame—both amplitude and period

the critical speed is reached, the amplitude will be maximum.

This process is based mainly on the fundamental principle that the maximum amplitude of the pivoted frame (which occurs when passing through the critical speed) is always in exact proportion to the amount of unbalance existing in the shaft being tested. This principle permits not only the measurement of the exact amount of unbalance in ounce-inch units, but also the determination of the exact angular location of the heavy side. Thus a mark may be made on the shaft or other objects being tested at the exact point where correction should be applied. As the measure of unbalance is the maximum number of scale divisions swept by the pointer, it is necessary to determine by test the value in ounce-inch units of each division. This value is called the "calibration constant."

With the counterweight set at the center, or zero position on disk K, the test piece is whirled and the amplitude reading noted on scale A. (Figure 5). This reading is the record of the free swing and the number of scale divisions covered by the pointer is the measure of the existing unbalance. The counterweight now is set at a sufficient distance from the center to create an arbitrary amount of unbalance in the disk K. A few trials will find the position at which the amplitude reading is greatest. In this position, the known unbalance in the disk, and the unknown unbalance in the test piece are acting in the same radial direction, and this amplitude reading is, therefore, the measure of the sum of the two amounts of unbalance. Because the unbalance of the disk is a known quantity, it is a very simple matter to determine the required calibration constant.

For example, suppose the unbalance existing in the correction plane of the shaft which is being tested is known to be 15 ounce inches, and that in testing, the maximum sweep of the pointer is observed to be 12 scale divisions: then the value of each division will be 15/12 or 1.25 ounce inches. The calibration constant is, therefore, 1.25.

With this correction arbitrarily applied, the machine is again speeded up and allowed to pass through the critical speed, as before. The second amplitude in this process bears a relation to the first amplitude which is dependent on the angle between the point of application and the point required. After determining and setting off this angle, a third run will check the result. For determining the corrections proportionate to amplitudes, and for ascertaining angles, the special calculating rule C, which requires but two settings, is furnished. This rule is also mounted on the instrument column at the left.

The Exact Point of Correction

After completing the first determination, the work is reversed in position and the correction is determined for the plane initially over the pivots, thus completing the operation. A critical speed of about 100 to 110 revolutions per minute is generally employed. This low speed prevents distortion of the work due to centrifugal forces.

In the precision balancing machine, we therefore have a means of measuring directly and exactly the amount and location of the correction necessary to furnish exact balance. This is a big practical step toward the complete elimination of the evil of vibration in modern high-speed machinery.

¶ *That the silkworm is being replaced by a chemical process is now an established fact. An authority on chemistry will, in our August issue, outline the way in which this is accomplished.*

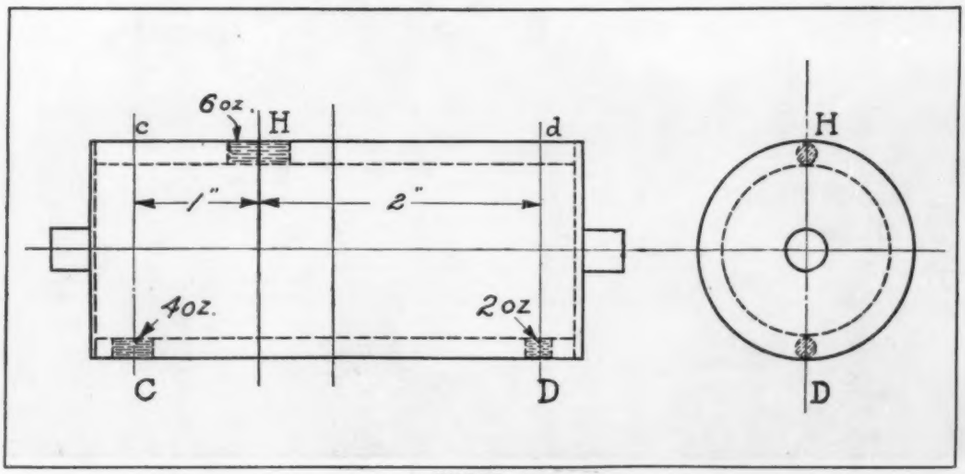


FIGURE 6

A diagrammatic representation of the method of overcoming static and dynamic unbalance H, by two counterbalances C and D placed at distances which are in proportion to their weights

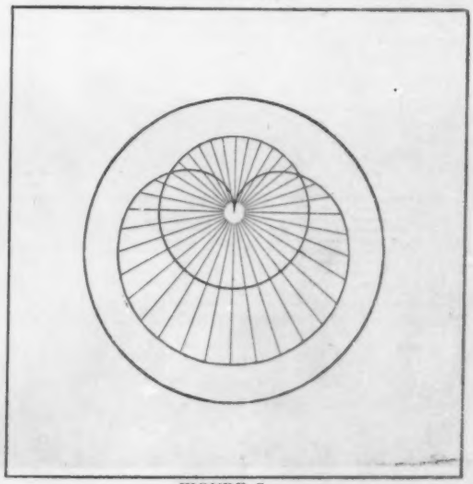


FIGURE 7

Based on this Chart of Angles, Newkirk's Law is developed and applied

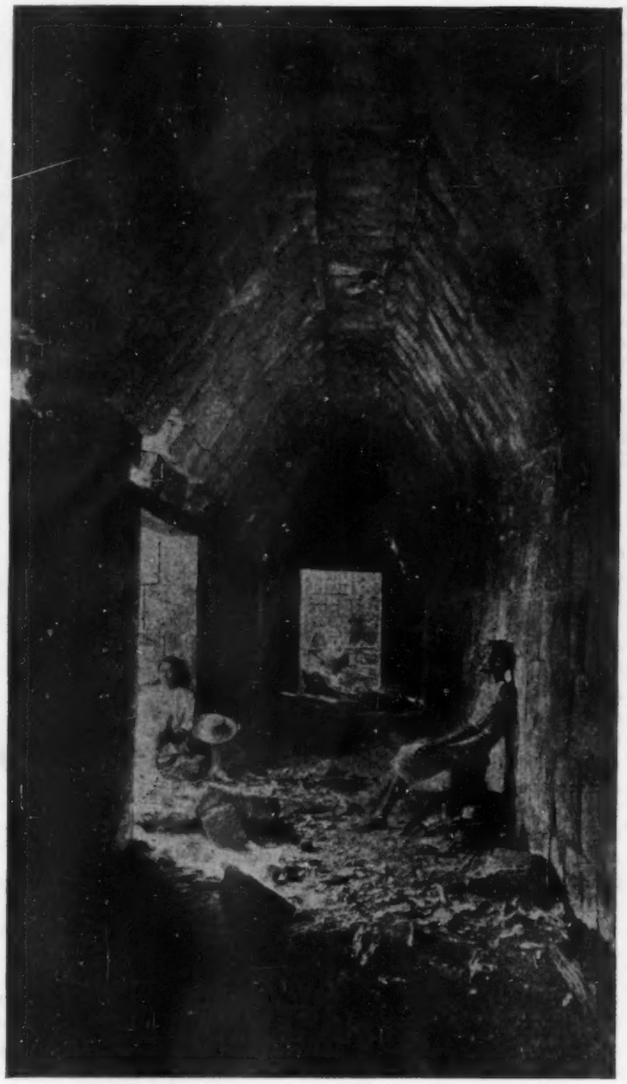
What Will the Next Ten Years Reveal in Yucatan?

Never before has the world devoted so much attention to the extinct civilization of the Maya Indians. Long ago a few archaeologists discovered some of the ruined cities of this once great people, yet it has taken decades for science to realize the extent and number of these ruins, and their significance. Moreover, only in comparatively recent times has the necessary money for their excavation been available. Today, work is proceeding as never before. The last excavating season saw at least three important expeditions in the field. The Mason-Spinden expedition explored an important area along the eastern coast of the Yucatan Peninsula. Dr. Thomas Gann, noted English archaeologist, worked in Yucatan, in connection with the British Museum. The Carnegie Institution has worked during two years under the able leadership of Dr. S. G. Morley, and plans have been made for the continuation of this work for another eight years. Important results should follow.

Only comparatively few of the ancient, ruined cities of the Mayas have yet been excavated. Many others have been discovered but given only preliminary attention. How many more lie buried beneath debris and concealed by the sub-tropical forests no one knows. But it is not unlikely that the coming decade will reveal many of the remaining secrets of the Mayas—perhaps even that of their inscriptions.

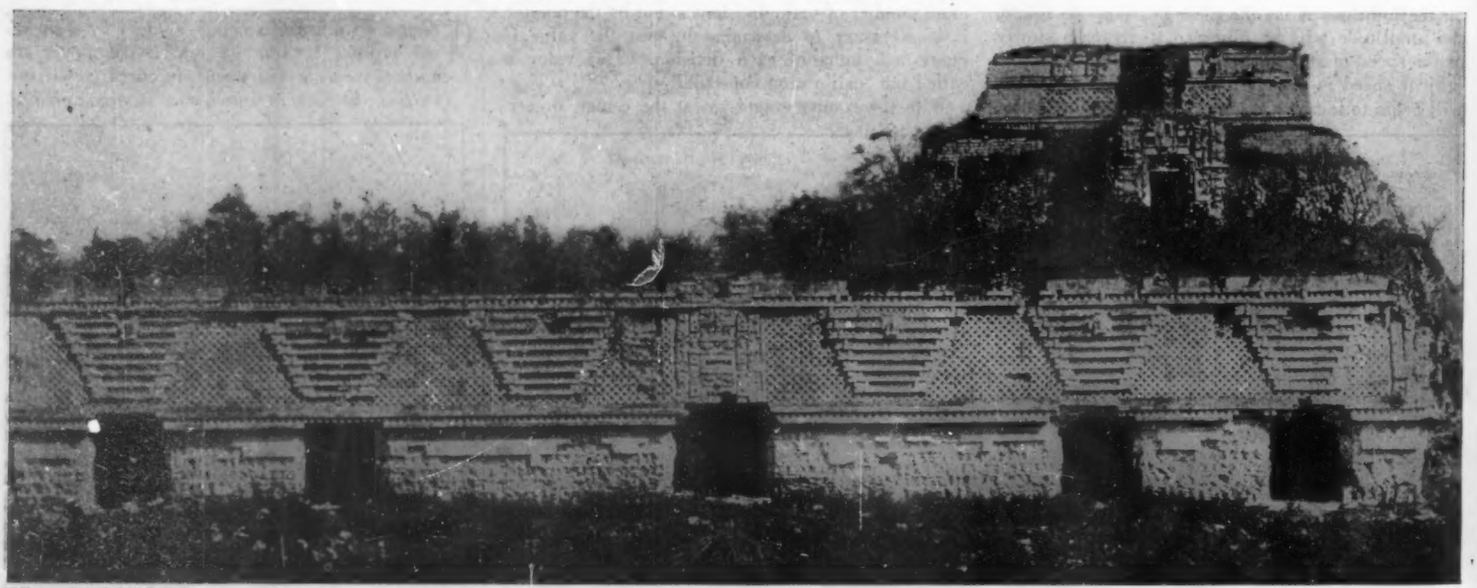
REASSEMBLING FALLEN RUINS OF MAYAN ARCHITECTURE

Very little is known about the Mayan hieroglyphs. The signs which have enabled archaeologists to work out important Mayan dates are now known, as are the symbols for the gods, the sun, moon and planets. It is not believed, however, that any of the inscriptions are purely literary, as are those found in Egypt, Mesopotamia and other parts of the Old World



AN ARCHWAY IN THE GOVERNOR'S PALACE AT UXMAL

This building, 320 feet long by 40 feet wide, contains two of these archways. The Mayan arch was simply a facing over a concrete filling. They did not understand the principle of the true arch with keystone, and their arch was therefore not as strong as such an arch would be



All Photographs by Kidder & Hartwell

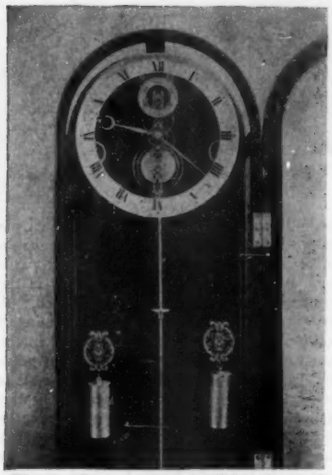
EASTERN SIDE OF THE NUNNERY QUADRANGLE AT UXMAL, WITH THE HOUSE OF THE MAGICIAN SURMOUNTING A PYRAMID IN THE BACKGROUND

At Uxmal there are five large groups of buildings, the Governor's Palace, the House of the Turtles, the House of the Pigeons, the Temple of the Magician and the Nunnery Quadrangle. In this picture the Temple of the Magician is shown on top of a pyramid 80 feet high, and 240 by 180 feet at the base

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins



The works are contained in the dial

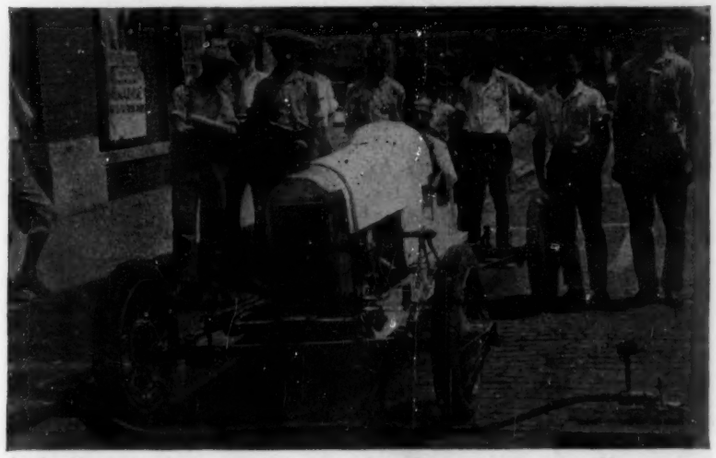
A New Type of Clock

ONE of our English correspondents, Mr. R. N. Pickering, a well-known clock designer and manufacturer of London, has favored us with photographs of a most interesting clock and a beautifully engraved dial. Mr. Pickering has discovered alloys which render steel parts and oil lubrication unnecessary. The movement is supported on a heavy back plate which is bolted to the case and which carries two massive pillars for supporting the frame. The frame, in turn, carries the time train and the twelve-inch dial. The frame is made of a circular ornamental plate and a front bar, placed one inch apart, thus allowing space for the barrel and other parts of the mechanism. The dial is silvered and the raised figures are of gilt. A smaller dial of similar construction shows the seconds. All the parts are richly gilded, pierced and engraved. The beauty of similar workmanship will be seen in our smaller engraving. The pendulum consists of a glass jar of mercury suspended in an ornamental stirrup.

An Accurate Method of Timing

AN inventor, of Anderson, Indiana, has devised an interesting hydraulic timing device for racing cars. The hose, as shown in the engraving, is an ordinary three-quarter-inch garden hose. When the driver is qualifying on the track, the front wheels force the water into the cylinder barrel which operates the lever. The lever, in turn, starts the stop-watch. After the lever or plunger is moved outward, the rear wheels have no effect on the hose, because after the car is on its qualifying lap, the plunger is pushed back to its normal position. As the driver crosses the hose again, it stops the watch.

Pierced dial for the regular clock



Hydraulic timing device for racing cars depends on the incompressible water in the hose

First Aid to the Picnic

NO longer need a picnicking party laboriously hunt a clean, level, grassy spot on which to spread a cloth for lunching. The trunk that rides in style on the back of the automobile and carriies all the supplies may be turned into two fair-sized tables and two stout benches on which the lunchers may sit. We illustrate a closed trunk and also one opened, to show the character of the furniture when in use. The sides, as will be noted, form the tables, and the double ends, the two benches. All are put together in a jiffy.

Anti-Pilfering Lockers

WE constantly read of students losing their clothing, et cetera, while attending classes. To obviate these losses from petty thieving, a plan is in use by which space behind movable blackboards in the classroom is utilized for lockers. The blackboards may be raised and lowered so as to give an opportunity for hanging up the clothes. When the blackboards are pulled down, the racks with the students' clothing are not visible.

The lower part of the sliding blackboard is of wood.

A crook-proof cloak room

When an auto trunk is not a trunk

A quartz and gallium high temperature thermometer

A New Scientific Thermometer

THE writer recently visited the wonderful laboratory of the General Electric Company at Schenectady and was shown a thermometer which, from all appearances, looked like the usual mercury-in-glass thermometer. Upon looking at the graduations, he discovered that a temperature of eighteen hundred degrees could be registered. The bulb and stem is made of fused quartz; and instead of mercury, which would boil and cause the thermometer to explode at such a temperature, gallium, one of the rare metals, is used. A temperature of one thousand degrees Fahrenheit is the maximum with the mercury-in-glass thermometer, and such thermometers are inaccurate at high temperatures. This is one of the first developments in the practical use of quartz tubing. Gallium is similar to mercury in appearance, but is much lighter in weight. It melts at a temperature of one hundred degrees Fahrenheit and can be cooled to about forty degrees before solidifying. Gallium boils at about thirty-six hundred degrees, so it is not necessary to have it under pressure in the thermometer.

A Toothbrush That Is Different

AN Illinois concern has put out a toothbrush that is quite different from anything on the market. It is round and made of stiff bristles which can penetrate between the teeth, thus covering spaces which are not touched by the ordinary toothbrush.

A toothbrush that rotates

Using the scraper to clean pots and pans

Combination Brush-and-Scraper Has Many Uses in the Kitchen

THIS combination brush-and-scraper has many uses in the kitchen in cleansing pans, dishes, or even scraping and brushing vegetables for cooking. Sticky food on the stew pans and fry pans may be easily scraped off with the scraper which is rigidly fastened to the edge of the brush. The brush is useful when using soap and water in cleansing particularly dirty pans. Potatoes and other vegetables which are usually quite dirty before cooking may be quickly cleaned with its aid. Since the device is usually sold for a dime, it would pay to have two, one for each purpose.

A Sensible Toy for Children

THERE has recently been introduced a new toy consisting of tin sections from which miniature buildings can be easily constructed by children. Sets composed of floor pieces, walls, windows, et cetera, may be

A spoon with a graduated bowl

had in varying sizes. The enameled floor pieces are made to receive a binding plate so that they may be attached to other floor pieces. Any style and size of building may be constructed with the binding plate as a basis. After the floor pieces have been joined together in the desired shape, the youthful contractor can fit the edges of the walls and windows into the grooves of the floor pieces. In case the building is going to be more than four squares each way, it can be braced by placing supporting walls between every second floor. The pieces may be had in various colors. The walls, floors and windows are made uniform in size.

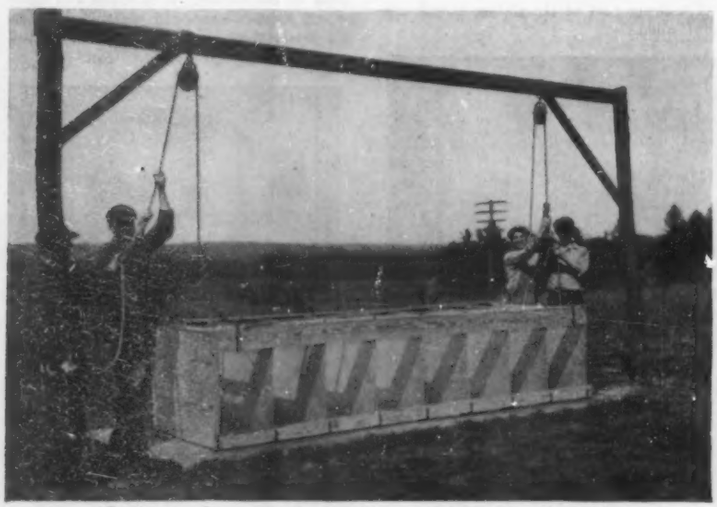
Putting together the tin sectional toy house

There are several types of windows, doors, cornices and balconies. If the boy's pocketbook is deep enough he can construct a replica of the Woolworth Building or any other tall structure. The units are small and are not easily broken.

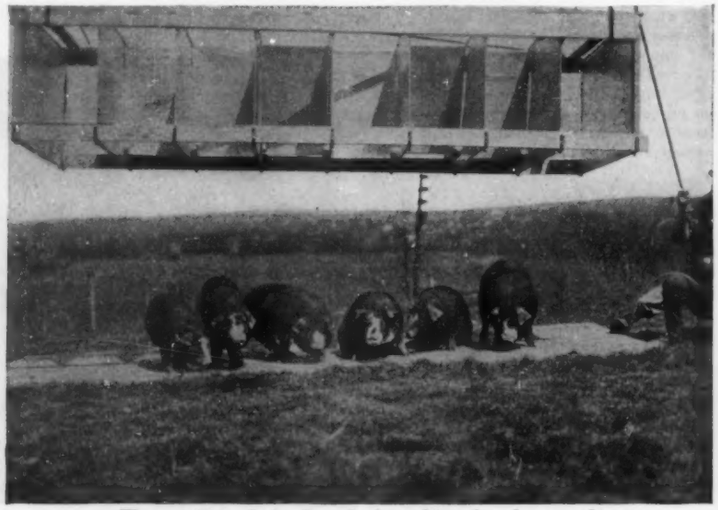
Interesting Method Used in Photographing Animals

THE art of focusing a camera on a group of pigs and securing good pictures has annoyed a great many photographers. A

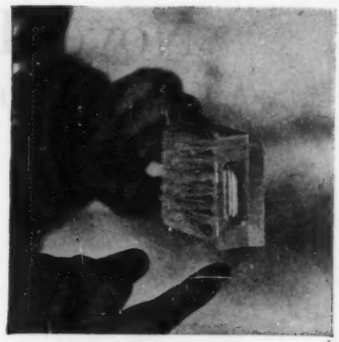
This animal group was posed by a new method



Getting ready to lift the partitions with the animals inside

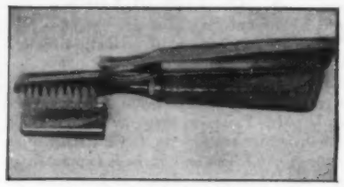


The partitions hoisted ready for taking the photograph



Scraper is attached to the edge of the brush

method evolved by the workers at the Ohio State Agricultural Experiment Station should be of value. A frame of galvanized partitions furnishing eight stalls in a row is the principal part of the apparatus used. A wire screen is used in the front of the stall while a galvanized iron gate is placed in the rear of each stall. With the frame in place the pigs are driven separately into the stalls so as to face the camera through the wire screen. The camera rests on a tripod at a certain distance in front and is focused on the pigs through the screen. As soon as the camera is properly focused, which may be done at the operator's leisure, the frame is



A magazine toothbrush

hoisted by means of overhead pulleys and exposures are made as soon as the frame is clear. This method does away with the annoyance of trying to get a number of obstreperous pigs to look their best.

Measure as You Mix

IN this kitchen spoon, the bowl is graduated so that solids or liquids can be measured. There is a pouring lip on the side of the spoon.

The Toothpaste Is Not Forgotten

IN this toothbrush, the paste is carried in the handle, and pressure on the tube feeds the paste to the bristles. Any standard tube fits the handle and the brushes themselves can be renewed. A cover slips over the bristles and a valve locks the supply of toothpaste when you travel.

An educational toy for children

A Wooden Library

THE "wooden library" is composed of blocks, which are hinged, as shown in the upper engraving. They may be folded together like a book. All sides of the "book" except the back are covered with entertaining pictures which vary to suit the taste of children of all ages. The blocks are almost indestructible; and they may be made into numerous combinations. Towers, bridges, lighthouses, bungalows, water wheels, arches, arbors, forts, houseboats, battleships and airplanes are among the many things which may be built with these blocks.

An Austrian car seal of novel design

The New Letter Boxes

ONE of the disadvantages of apartment-house dwelling is the inability of the ordinary mail boxes to hold magazines. Of course, where there is hall service there is no difficulty in securing second class mail; but many thousands of apartment houses are now being built on the "walk-up" plan with the result that there is no hall service. The magazine problem remained unsolved until a couple of years ago when the Post Office Department permitted a new type of delivery box to be installed which is sufficiently large that magazines may be inserted in tenants' boxes. There are several styles of such boxes on the market; and we show one which has been approved by the Post Office Department. The idea is to have the upper portion of the box opened up by the postman who puts in magazines or other articles. The tenants can open the box with their regular keys. Each individual box is eighteen inches high, four and one-half inches wide, and four inches deep, and is thus of ample size to accommodate the largest magazine published.

The boxes are designed for flush mounting. The body is constructed of cold rolled steel, finished with rustless black enamel. The fronts are of heavy die-cut brass, standard brush brass set in ebony finish frames. The upper, or master door is made in one piece and extends the entire length of the unit. The door, nine inches high, provides ample room for the deposit of all mail matter. This door is secured by a Government lock, furnished and installed by the local postmaster, on demand, free of charge. The lower or individual doors are also nine inches high, enabling the tenant to readily remove his mail. Each box is furnished with individual lock and keys and name-card holders, and each box is a steel safe in the wall of the building.

Tool for placing chains on auto tires

This new type of mail box accommodates long magazines

A Comfortable Hair Cut for the Child

THE device shown converts the adults' barber chair into a comfortable chair for children. In our large cities we have in department stores barber shops for children only. The chair for the child is carried normally at the side of the adults' chair; and it is swung into place in an instant when the youthful customer enters the shop. Children have a dislike for the barber shop because, perched upon a slippery seat without support, they soon tire; but this arrangement will help to make them happy.

Reading the bookie blox—a combination toy and book

A child's chair for the barber's use

A Radio Clock

A BROOKLYN inventor has devised a dial for a clock which will help DX fans to time their far-away stations. The dial carries the names of the units of standard time, such as "central," "mountain," "Pacific," et cetera. The dial can be applied to any clock.

A Useful Tool for Putting on Chains

SERVING as an extra hand, even substituting for the fingers, a recently invented tool for placing chains on auto tires is designed to save time and labor. It makes the job easier and more secure, and it eliminates the unpleasant task that was faced when chains were put on only by hand. It is a metal bar having a second bar attached close to one end; and it is applied to the chain to pull it to proper tension without effort.

A clock for DX fans

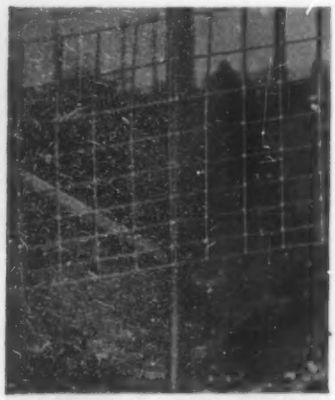
A Car Seal That Has Been Adopted by the Austrian Government

THE combination lock-car-seal shown on this page may be used on post office trucks or mail bags. In Austria, the freight cars are sealed and the combination is sent on by railway-mail. The post office trucks have a fixed code for every day which is changed in different localities.

A Chemical Windshield Wiper

A NEW windshield wiper is made in the shape of a handy mitten. One rub is good for a number of hours. It is a chemically prepared felt mitt that fits the hand, impregnated with a harmless, odorless chemical. It can be applied to automobile windshields, street cars, locomotives, and even store windows.

A wiper for automobile wind shields



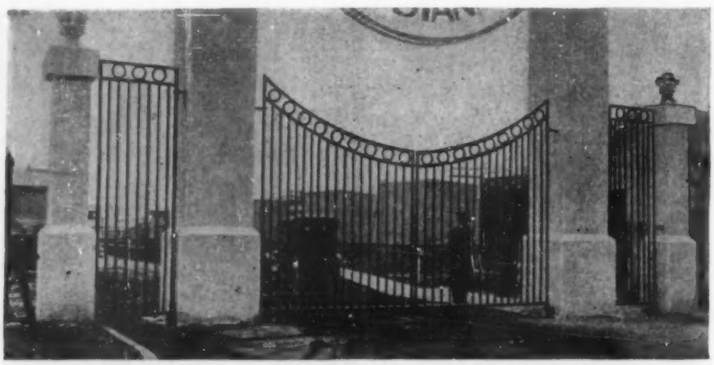
A fence with all joints welded

Fences from Scrap

ONE large plant recently had need of a strong, yet not ungainly fence, with an impressive gateway. They had an ingenious employee who saw the connection between a nearby junk pile, an oxy-acetylene blowpipe and the company's need. The first step consisted of providing pipe of correct diameter from the junk pile and then cutting it to proper length. This was readily done with the cutting blowpipe. It proved a simple matter to weld short pieces together. When a good supply of usable lengths was on hand, assembling began. Heavy wire netting was used for fence covering between posts. The apparent difficulty of attaching the wire to the posts was easily overcome by using the cutting blowpipe; U-shaped cuts were made in each post and the tongue formed was bent inward over strands of heavy wire. The method insures strength and durability. The attractive gateway shown was made in the same manner. As the gateway was to be more ornate, a little more time and thought were spent in its construction. Our engraving shows the very artistic results attained. Carefully graded lengths of pipe were welded to a straight supporting cross-beam of heavier pipe; two bent pipe lengths rounded off the top of each large gate. These graceful bends were made after heating the pipe with an oxy-acetylene flame. Then cross sections of large diameter pipe were cut with the blowpipe, and were welded at intervals along the top of the gates.

A new type of dough mixer

Prevents doors slamming



This ornamental gateway was made from oxy-acetylene welded pipe

Breaking This Pencil Point Sharpens It

IN this pencil all of the points come ready-made for you in a single strip of filler. Break off one point and another is ready to take its place. The "filler" is held in place by a thin piece of metal which makes breaking very easy. A pencil of this kind is a great help to the busy man.

Taking the "cars" out of the apartment house garage in New York

A Wire Dough Mixer

AN extremely rapid device for use in the making of pies and biscuits is illustrated. Its shape keeps a permanent tension on its ten cutting wires; and these spring aluminum knives keep cool during mixing.

Door Check Keeps Key in Lock Also

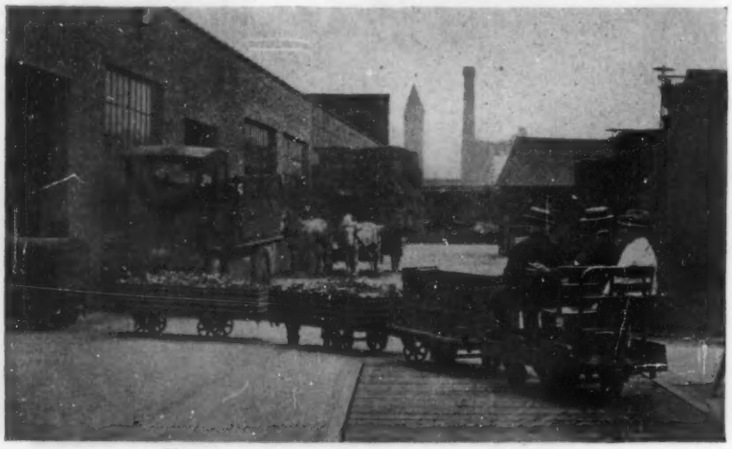
THIS invention answers two purposes. First, it prevents doors from slamming and makes possible ventilation through the door at any angle. Second, the same device can be used to run through the hole in a door key to keep prowlers from pushing the key out and picking the lock.

Fatigueless Inspection

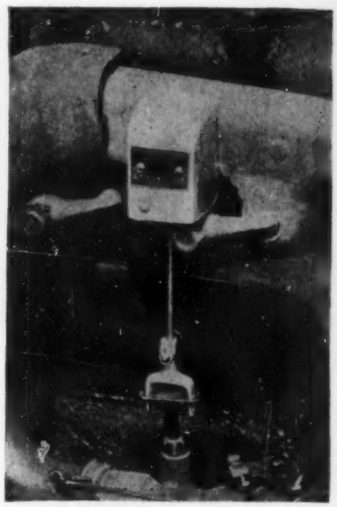
THOSE who have occasion to visit large plants know the great fatigue which is experienced after a day's tour. To obviate this condition, a Chicago concern has devised a small truck, provided with seats, for inspection by executives, works managers or visitors. This trailer can be attached directly to a tractor or to a tractor-train as shown.

A Baby Carriage Garage

NEW YORK is in great need of modern housing; and it is hoped that soon the greater part of the slums will be redeemed by the introduction of modern tenements giving plenty of light and air. In one of the houses of the Hudson Guild, accommodating 45 families, a garage for baby carriages has just been installed. Each of the families living in the house contribute five cents a week, whether they have children or not, for its upkeep.



Shop inspection trailer saves executive fatigue



Adjusting the gasoline supply

Automatic Gasoline Control

WITH this device, when the motor is cool, more gas is admitted; but when the motor has warmed up less gas is needed and the amount of gas admitted is reduced. A coil of thermostatic metal is so placed that when the motor warms up, it expands, turning a rod, one end of which is attached to the control lever of the needle valve. This operation cuts down the amount of gas supplying the carburetor. When the motor is cold, contraction reverses the process.

A wrist score card

A pencil that is always sharp

Combination lock for automobiles

Combination Lock for Automobiles

THE object of this device is to provide an automobile lock which may be attached to the steering post without interfering with the manipulation of the steering gear by an authorized person who knows the combination of the lock. The casing of the lock supports a locking bolt which controls the movement of the steering post so that when the bolt is advanced the steering post cannot be turned. The movement of the locking bolt is controlled by tumblers, as in a combination lock. When the tumblers are properly positioned, radial slots will register so as to allow of the passage of the head of the locking bolt. There is an indicating dial on the outside of the case.

Testing a New Moving Sidewalk

PARIS has always been to the fore where transportation is considered. The French metropolis is so vast and the traffic is so

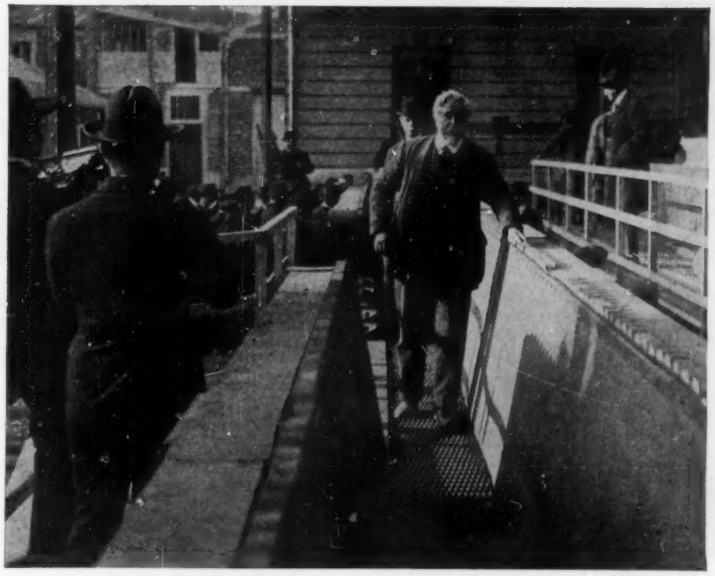
A funnel for many uses

congested that anything which will tend to do away with moving vehicles is certain of a test. A new type of moving stairway was recently tried out at Bellevue, a few miles from Paris. The upper illustration shows a practical test of the device, and the lower engraving shows how the hand-rail is operated in comparatively short sections. If the rail was in very long sections, the friction would be very considerable.

Collapsible Automobile Seat

AT the recent Olympia Motor Show in London, one of the novelties was an air-cushioned seat which is collapsible in every detail, even to the supporting stand and feet. The construction is plainly shown in the engraving.

Taking the warp out of the large ice-chest



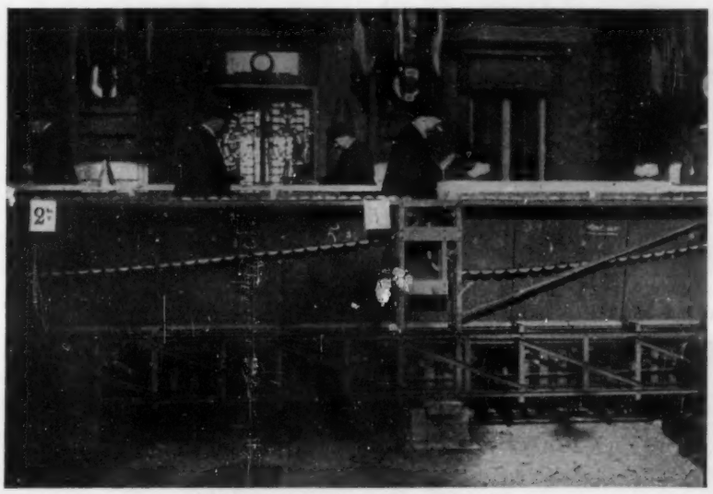
Testing a new moving sidewalk in Paris

Keeping Refrigerator Doors Tight

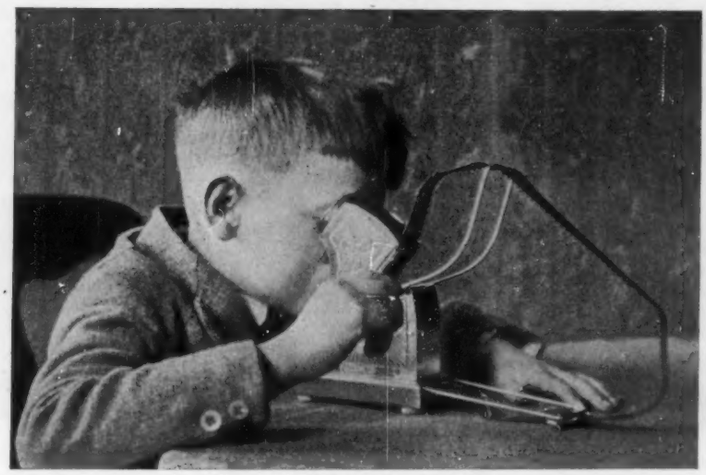
TO prevent warping of refrigerator doors, a door truss has recently been invented by a Chicago man. This truss is formed of two steel rods. It may be used on new doors or it may be applied to doors already in use. It keeps doors straight by pressing the warped parts tightly into alignment. By turning a part of the truss at the center, where the rods meet, the rods may be tightened by shortening or increased in length when the door expands.

Movies in Daylight

A NOVEL moving-picture machine toy, which has recently made its appearance in this country from abroad, can be used in daylight. The pictures are viewed through an aperture equipped with a magnifying lens. The film is moved by a crank at the side; and each individual picture, or pose, is automatically held stationary for a fraction of a second between this lens and an opening immediately at the rear.



Mechanism of the moving sidewalk



Movies in miniature in daylight

An extra seat for the car

A Funnel That Mixes, Measures, Pours

A NEW funnel fits all standard screw-top fruit jars, ranging in size from one-half pint to one-half gallon. Screwed on the top of any single jar, it converts the jar into a bottle which pours easily. The funnel is also a measuring cup.

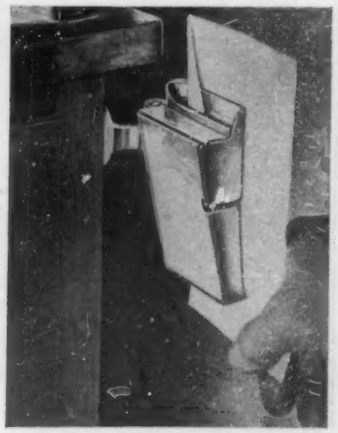
A soap tablet

Kind to Greasy Hands

THERE is on the market a handy soap tablet which removes grease, leaving the hands soft. It is a composition of soap and sawdust with glycerine. When a small amount of water is poured into the palm of the hand on the tablet, the tablet swells, absorbing the water.

An Envelope Sealer Without Moving Parts

IN this device the envelope is closed by merely passing it through the sealer by a single operation of the hand as shown in the illustration. The idea of a small sealer without motors or moving parts is that every department of an organization can have one.



A simple, individual envelope sealer

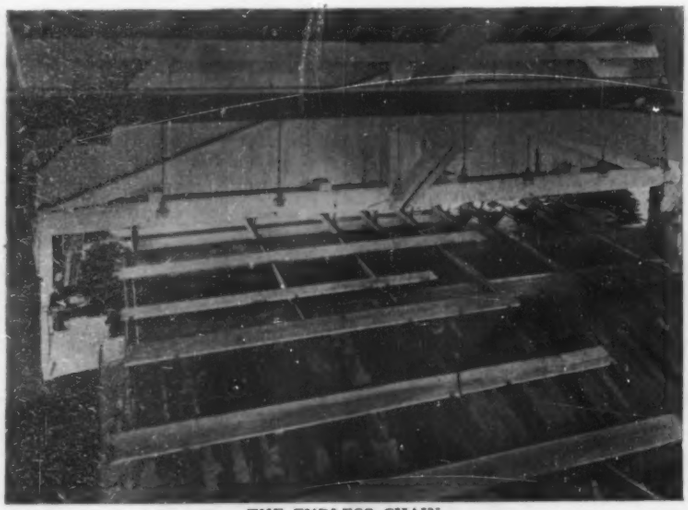
Branding Timber by Machinery

FRESH FROM THE BRANDING MACHINE

Branded lumber showing the cypress and mill marks that serve as identification

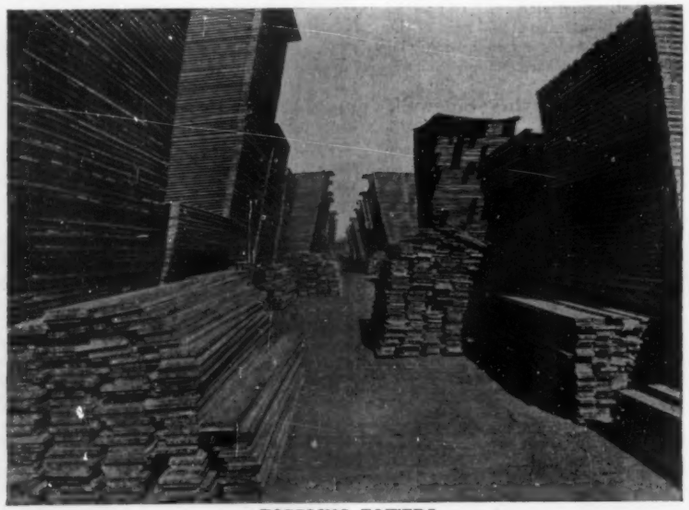
Ends of Lumber Branded

Even as sheep are branded, so is lumber. Producers of cypress lumber in particular have found it advantageous to brand each piece with marks which will indicate at once that it is cypress, and will also designate from which lumber mill it comes. To this end, the lumber is carried by endless conveyors past a revolving metal drum, the entire face of which is embossed with the necessary patterns for the branding. As each plank or board passes the drum, it halts momentarily and is held in place by a shoe located beneath it. The drum stamps its impressions on the end of each piece, which then passes on to the yards to be piled with its neighbors and held ready for shipment as required.



THE ENDLESS CHAIN

Looking toward the branding machine. Note the lighting equipment for night work



TOPPLING TOWERS

Here are piles of lumber which have been branded and are ready for stacking

READY TO BE BRANDED

The boards to be stamped are brought up in trucks to the endless chain, to which they are transferred. Then they are carried down to the branding machine

The Scientific American Digest

Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

A Marvel of Modern Reconstructive Surgery

How a skillful and sympathetic surgeon provided an armless boy with two movable and useful arms made from the boy's own body is the remarkable feat described in a recent issue of the *Journal of the American Medical Association* (Chicago).

By X-ray examination, it was seen that this boy's absolutely armless shoulders concealed a small, under-developed fragment of the humerus three inches long on the right side and about four inches long on the left. An operation freed these rudimentary bones, muscle was obtained from the chest and built on them, and the boy was then carefully trained to employ these muscles. He is now able to perform complicated tasks and even to operate a typewriter.

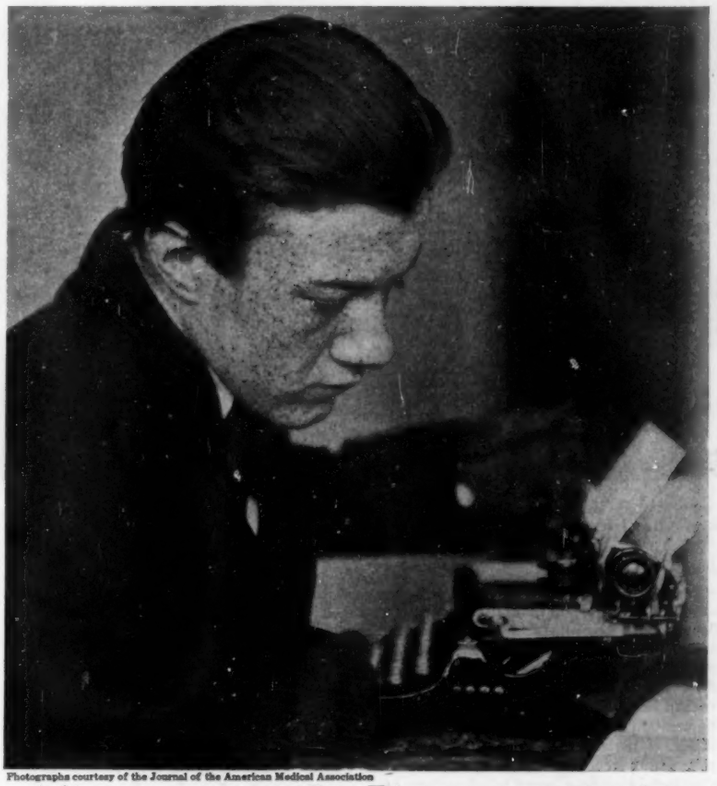
The boy's name, stated in the source quoted, is Henry Wiegman. (The writer of the present abstract has previously obtained his sanction to present a brief account of the remarkable surgery by which he was provided with a pair of arms—Henry believes, in fact, that "it may do some other fellow some good.")

The operation was performed in 1920, but the surgeon, Dr. Harry E. Mock, of Chicago, purposely waited a few years to see the results before publishing his report. Henry, at the age of twelve, was an unusually bright boy, says Dr. Mock. He was up with his class and showed a marked talent for drawing. Under the patient care of his mother and sister, he had learned at two to scoot, at four to walk, while at six he could hold a pencil between his cheek and shoulder and make lines. At seven, he could thus write and draw. He opened doors by grasping the knob between his cheek and shoulder, while the little wooden Santas sawed out by a scroll-saw held in his toes became famous. At eight he became expert on the typewriter, but could operate it only by striking the keys with a long stick held between the cheek and right shoulder.

At twelve, Henry began to want arms and sleeves, and his case was then studied for the first time from the point of view of reconstructive surgery. The examination showed two small elevations of the chest wall at the poorly formed shoulders. On both sides, there was a fairly developed posterior portion of the deltoid muscle, the muscle that caps the shoulder. Two short fragments of the bone of the upper arm were found by X rays, as mentioned above.

The surgeon states that at the time these examinations were made by himself and several members of St. Luke's Hospital, "none of us ever dreamed of the development in these rudimentary humeri that had occurred." In June, 1920, he operated on the right side, making two four-inch incisions and dissecting out a flap of skin which was to cover the under surface of the stump after the rudimentary bone was freed.

Through physical exercises, Henry's newly made arms were strengthened



Photographs courtesy of the Journal of the American Medical Association

At his present age, seventeen, Henry Weigman can operate a typewriter efficiently. He was born without arms but skillful surgery provided him with arms of flesh and bone

The bone, about the diameter of that of a two-year-old child, was carefully freed so that it could be pulled out at an angle of 30 degrees. There was now presented a small, rudimentary humerus three inches long, covered with the muscle mentioned. To this was attached the *pectoralis major* muscle from the chest. A skin flap from the chest wall was wrapped around it. Two weeks later, the left side was similarly operated on. Neither of the wounds became infected and the patient made an excellent recovery.

The boy now had two small stumps, but lacked the ability to move them in any direction. So, in two months, Henry went to the Spaulding School for Handicapped Children, where Miss Jane Neil, the principal, and Miss Carney, the chief physiotherapist, gave him a thorough course in muscle training exercises. In four months, the stumps became firm and muscular. Henry could raise them to a horizontal position. He was ready for artificial arms.

Just before Christmas, Henry received his new artificial arms and came to the hospital dressed in a new suit and shirt, both of these garments having sleeves—the first sleeves Henry had ever had. "With his new arms in these sleeves," says the doctor, "he looked like any ordinary healthy boy, but I doubt whether there was ever a prouder or happier child. Within a half hour, he was able to grasp a pencil in the clamp attachment at the end of his right arm, could write better than most boys of his age and could draw better than when he held the pencil between his right cheek and shoulder. A little later, he returned to the Spaulding School, and just before entering Miss Neil's office, he asked Miss Carney to throw his overcoat over his left arm and place his cap in his left hand. Then he marched in and put out his right hand to his friend, the principal, 'just like a gentleman' as he expressed it. That noon at luncheon at the school, he grasped a spoon in his right hand and ate like other boys, instead of 'lapping his food like a kitty.'"

"From all accounts," continues the surgeon, "his homecoming that evening and the surprise he gave his mother, who did not know that his artificial arms were ready and who had never seen his new suit, was very impressive. It must have been, for it is impossible to describe the choky sensation that a number of us doctors had that day at the hospital as Henry displayed his 'first sleeves, and sleeves with arms in 'em.'"

Henry can make his right transplanted pectoralis muscle stand out like a biceps, and he gets the same pleasure out of "making a muscle" as any boy does who flexes his arm. He now has a new pair of artificial arms, having outgrown his old ones. He paid for the new pair himself with money he made from the sale of his artistic Christmas cards which he designed and made from wood cuts. He has attended the Art Institute the last two summers and is becoming a real artist. He does practically everything for himself.

This case demonstrates the need of coordinating the work of reconstructive surgery and education, Dr. Mock points out. The two are inseparable in rehabilitating the disabled. The surgeon has a great opportunity to inject ambition into his patient, to tell him of the accomplishments of others similarly handicapped, and finally to place him in the hands of those lay agencies which give a continuity of service that will assure the final economic end-result in every case of permanent handicap.

What has been done for this boy can be done for great numbers of congenital and acquired deformities in both children and adults. The study of these cases from the point of view of rehabilitation opens up new and exceedingly interesting avenues of surgery.

* * *

Synthetic Rubber, Is There Anything in It?

If the price of rubber stays up, sooner or later synthetic rubber will be sure to make its appearance, says *Industrial and Engineering Chemistry* (New York). It would appear that petroleum will be the cheapest source of the raw material. Yet this technical journal holds out slim hope for a future synthetic rubber industry.

What of synthetic rubber? Sharply conflicting statements concerning it pop up from time to time. "It has never been successful commercially," say some. "It will soon be a big success," say others. Moreover, the situation has been confused in some instances by unscrupulous promoters of stock sales, who do not hesitate to promise riches to the "ground floor" investor in improved processes for making synthetic rubber.

Whether or not rubber has already been made synthetically, depends, in the last analysis, on what is meant by rubber. The word rubber, like many other terms, is elastic. If we conceive it to mean hard rubber, for example, then we can certainly say rubber has already been made synthetically. What the world wants, however, is not some special kind of rubber having limited usefulness, but plain *rubber*—synthetic rubber that can be substituted successfully and satisfactory for the plantation rubber of rubber gloves, rubber boots, rubber balls, and especially automobile tires. Dodging all "ifs" and "ands," no such product, synthetically made, yet exists. But there is ground for hope, say chemists, who are at work on the problem.

During the war, the Germans made two types of synthetic rubber. The product of the cold process, known as "H" rubber, was successfully used for hard rubber articles, particularly submarine battery jars, but the product of the hot process, known as "W" rubber, never came into extensive use.

The Germans, it is stated, made their rubber from acetone, but nothing is positively known of the yield or the cost. One estimate of the cost of materials is forty cents a pound. The cheapest source of material is petroleum, although butyl alcohol and amyl alcohols may be employed.

Even should the price of plantation rubber fall to 25 cents a pound (the cost of production, plus a fair profit) synthetic rubber might have to meet this price in order to compete at all. Although, so far, the raw materials have been too costly to make synthetic rubber a real competitor, the present high prices (ninety cents in January, 1926) if continued, will be a challenge to the laboratory, and one never knows from what test tube or from what catalytic bomb a

At the age of twelve—a case of congenital absence of both arms

Harris & Ewing

Candy produced from corn by the new process developed at the United States Bureau of Chemistry

Harris & Ewing

Maltose sugar made from corn. That in the bottle on the right remains in the raw, lumpy state

revolutionary discovery may be brought forth.

Writing in the same journal (April, 1926) L. E. Weber, a Boston consulting rubber chemist, states that there is some difference of opinion as to whether or not it can be claimed from the commercial standpoint that crude rubber has been synthesized successfully.

The manufacture consists of two distinct operations: (1) the manufacture of the parent hydrocarbon, and (2) the polymerization of the hydrocarbon. (Polymerization, the change of molecular weight without change of percentage composition. For example, benzene, C_6H_6, is a polymer of acetylene, C_2H_2.)

The first operation, the manufacture of the parent hydrocarbon, varies with the raw material used, whether coal tar, starch or petroleum. If starch, the carbohydrates are converted into iso-amyl alcohol by fermentation. The iso-amyl alcohol is then converted by means of hydrochloric acid into an iso-amyl chloride, and the latter in turn is converted to the dichloride by means of chlorine. Finally, passing the dichloride over soda lime yields isoprene.

Another approach may be made by way of acetone, which it is hoped, incidentally, may some day be made from coal. The acetone is reduced to pinacone by the action of aluminum and caustic soda, and methyl isoprene is produced from this by distillation under pressure.

Having made either isoprene or methyl isoprene, the second step is their polymerization. Either product is placed in steel drums and allowed to remain at a temperature of 140 degrees Fahrenheit. By another process, metallic sodium in wire form is added to the isoprene or methyl isoprene and the two are left together two or three months.

Examining synthetic rubber in the light of the conditions it must meet in order to compete with plantation rubber, the author quoted discovers that it meets the requirements only to a minor degree. The elasticity and abrasive resistance of soft rubber articles at present produced from vulcanized synthetic rubber are comparable, if at all, to only the lowest grades of plantation rubber. Synthetic rubber ages poorly. Its plasticity is very deficient.

On the other hand, the progress which has been made represents beyond question the greatest achievement of synthetic organic chemistry—it is the first and only natural organic colloid which it has been possible even remotely to duplicate in the laboratory. Beyond question, he says, the synthesist will ultimately produce a product equal in quality to natural rubber. "The dispassionate weighing of the facts," he continues, "prompts the conclusion that the synthesist has yet to devote much labor and effort before he can lay claim to having reached his goal, and under these conditions, the creation of an impression that synthetic rubber, if not actually near at hand, is at least within reach, is unfortunate because it arouses immediate hopes which cannot be fulfilled."

And the minute the synthesist produces synthetic rubber equal in quality to the natural product from some cheap raw material, the plant biologist, who has already shown us what he can do by increasing the natural 2 percent content of sugar in sugar beets to 18 percent, will loom up "with the rapidity of the prophet's gourd" and quash the infant industry. Gloomy outlook. "The chances of victory for the synthesists look slim," says *Chemical and Metallurgical Engineering* (New York), but the *India Rubber World* (New York) sees in the situation a little light, for says that journal, "even though costing 50 cents a pound, it should prove the best kind of a crude rubber stabilizer."

* * *

From Corn to Sugar in Ten Hours

"INSTEAD of sending their corn to market on the hoof—in the form of hogs and beef cattle—farmers, in the future, may market a fraction of this cereal crop via the sugar-barrel route," says S. R. Winters. Sugar from corn is now possible in quantity production, two chemical processes having been developed for the commercial manufacture of sweetening from America's biggest grain crop.

Methods for extracting sugar from corn are not new to chemists; but a revival of interest in the possibilities of corn sugar has been brought about by the surplus from the 1925 three-billion-bushel corn crop, which is a depressing economic factor to the corn growers of the Middle West, and by a bill which is pending before Congress. This bill, if enacted, would admit of the marketing of corn sugar or dextrose on a par with sugar from cane and beets, without any distinguishing label.

The latter proposal is, however, being stubbornly contested by supporters of the Pure Food and Drugs Act, as well as by the manufacturers of cane and beet sugars. Dextrose, the product now being extracted from corn on a commercial basis, is said to be only 50 percent as sweet as sugar made from cane or beets. Dextrose is less soluble in water than cane or beet sugar and, according to claims, it has a flavor peculiarly its own.

The bill introduced in Congress by Senator A. B. Cummins and Representative Cyrenus Cole of Iowa would amend the Pure Food and Drugs Act so as to admit of the sale of dextrose, or corn sugar, without any label or differentiating mark from that of cane and beet sugars. This legislation, if favorably passed upon, would give corn sugar a rating, at least in the market places, commensurate with that of cane or beet sugar, though the latter is 100 percent sweeter. Dextrose, a comparatively new commercial product, would, by virtue of artificial legislation, share the popularity which has so long been accorded to the old and standardized products from cane and beets—"sucrose" or sugar, if you please! Let every tub stand on its own bottom, in a measure, is the admonition of Secretary of Agriculture William M. Jardine and food administration officials of the Bureau of Chemistry, in their insistence that food products be properly labeled in accordance with the Pure Food and Drugs Act.

Supporters of the legislation favoring the liberalizing of the Pure Food and Drugs Act so as to admit of the sale of dextrose under the general classification of sugar are prompted by motives that are deserving of some consideration. Aside from its commercial aspects, that of artificially boosting the market value and consequent demands for corn sugar, such legislation is designed to

Harris & Ewing

Making maltose sugar in the laboratory—the vacuum pan. The apparatus was designed by the Bureau of Chemistry

alleviate, though in a small way, the distressing economic factor of an overabundance of corn, without visible markets for the surplus.

Dextrose can be produced more cheaply than cane or beet sugar and therefore could be marketed at a correspondingly lower price than the standard sweetening. Thus, if we are to believe the arguments of the supporters of the Cummins bill, corn sugar would be used in appreciable quantities in the canning of fruits, vegetables, condensed milk, preserves, jellies, and in the manufacture of ice cream.

Meanwhile, our attention is drawn for the moment to a comparatively new process for the manufacture of sugar from corn which has been developed by the Bureau of Chemistry of the United States Department of Agriculture. By this process, "sugar" is made from corn starch or from corn hominy and is designated as maltose sugar. It is not, therefore, to be confused with dextrose or connected with the legislation over the latter product which is now engaging the attention of Congress. Moreover, the Bureau of Chemistry is a strict conformist to the laws which it is empowered to enforce upon others—that is, it gives this corn product a distinguishing mark, maltose sugar, in deference to the will of the Pure Food and Drugs Act.

Mr. Winters describes the process of manufacturing maltose sugar as follows: "A vacuum pan, with its controlling mechanism, is the heart of the equipment, the mashing of the hominy with malt serving to liquefy the product and then completely convert the starch into white sugar. This simplicity of equipment and procedure would seem to imply that farmers could make their own sugar; but the Bureau of Chemistry warns against the attempt because of the technique involved in controlling the apparatus. However, it is not unreasonable to assume that with a further simplification of this control, educated farmers, trained in the laboratories of our agricultural colleges, would be competent to manufacture sugar.

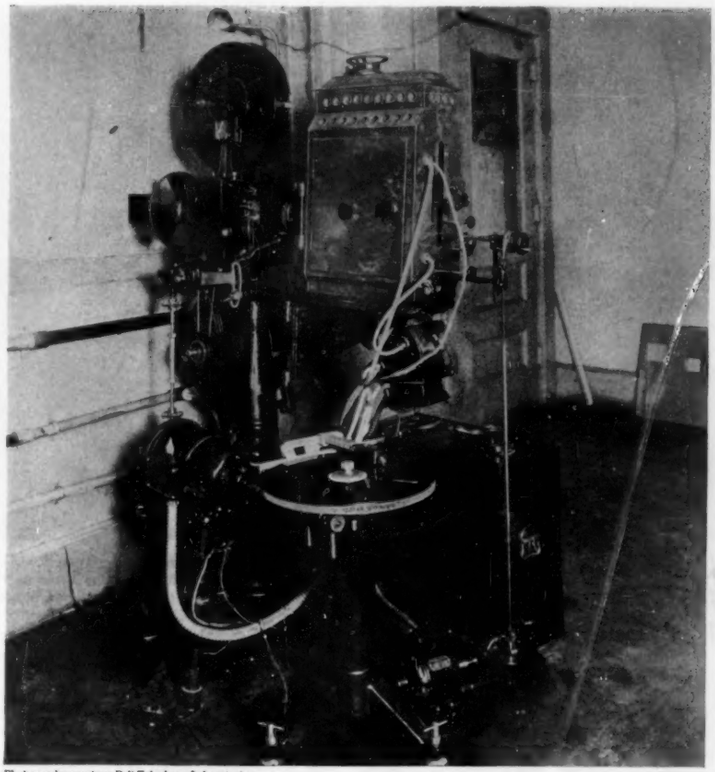
Of the process of making maltose sugar from corn, the United States Department of Agriculture speaks officially as follows:

"That it is possible to make crystalline maltose sugar from corn starch has been known to chemists for many years, but control of the process has been lacking, and it has not been possible heretofore to produce crystalline maltose sugar from starch economically. The new method enables the chemist to control the process so that it proceeds with regularity and certainty. The process is simple and involves no unusual equipment. The final cost will be low, so that the maltose sugar can be produced at a comparatively low cost, as low or lower than cane sugar.

"The new product is obtained in the form of fondant-like masses and not in a granulated form like granulated cane or beet sugar. It can be melted and cast in molds like fondant made from cane or beet sugar. It may be used in the candy industry in producing chocolate cream centers and other cream confections.

"The process consists essentially of mashing either corn starch or corn hominy with malt, which liquefies the product and in the course of from 7 to 10 days completely converts the starch into maltose sugar. After decolorizing with carbon and evaporating to a given density, the sirup is allowed to cool and is then inoculated with a little crystalline maltose and allowed to stand from one to several days at room temperature, when it sets into the solid crystalline fondant, the crystals being so fine that they can hardly be distinguished under a high-power microscope.

"This new advance in producing crystalline masses of maltose sugar from corn has yet to be industrialized so that it is too early to realize its bearing on the utilization of corn. The investigational work is not entirely complete, but has proceeded far enough to demonstrate that it is entirely practicable to make an excellent grade of crystalline maltose sugar from corn starch or hominy."



Photographs courtesy Bell Telephone Laboratories

The projection machine for the new talking motion pictures. It is as easy to operate as the ordinary motion picture projector

* * *

Motion Pictures That Talk—a New Method

SCIENTIFIC developments which will revolutionize the presentation of motion pictures in the largest metropolitan theatres as well as the smallest theatres in the little towns have just been announced as perfected by the Western Electric Company and Warner Bros. Pictures, Inc. These developments are the result of years of research in the Bell Telephone Laboratories, the research laboratories of the American Telephone and Telegraph Company, and the Western Electric Company. They involve a system for the synchronization of motion pictures with reproduced sound having a degree of naturalness never before attained.

This invention brings to audiences in every corner of the world the music of the greatest symphony orchestras and the vocal entertainment of the most popular stars of the operatic and theatrical fields. The recording and reproducing system is available to all motion picture producers for synchronization with any film that they produce. Its use is not confined by any means to the presentation of pictures. It will be available for use in the educational, commercial and religious fields as well as that of amusement.

Scientists consider this system to be a distinct advance not only in the motion picture field, but in that of voice communication as well. The invention will make it possible for every performance in a motion picture theatre to have full orchestration accompaniment to the picture regardless of the size or character of the house. A corporation has been formed to record the synchronization of music for motion picture producers all over the world and to distribute the invention among theatre owners.

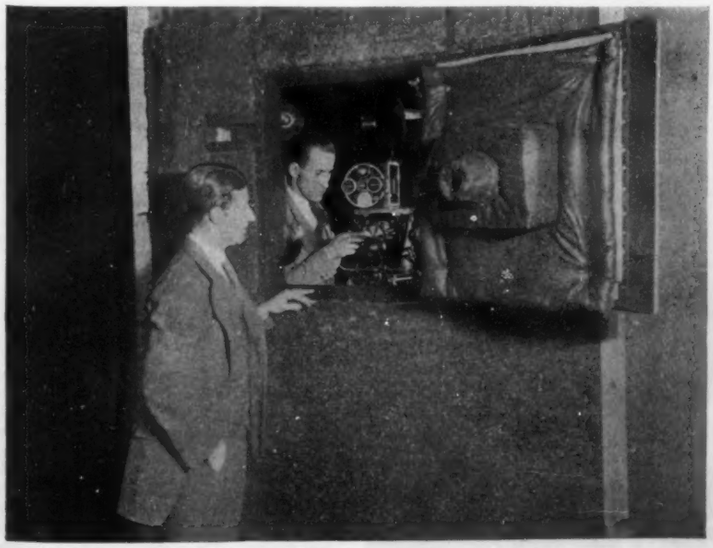
The apparatus by which films and sound records will be simultaneously reproduced in motion picture theatres is no more complicated from the standpoint of operation than an ordinary motion picture projector. No special skill or technique is required of the operator. If the film breaks, there is no interference with the accuracy of synchronization. The sound record is not controlled by the film itself.

The system represents successful combination and conversion to motion picture use of three major research developments.

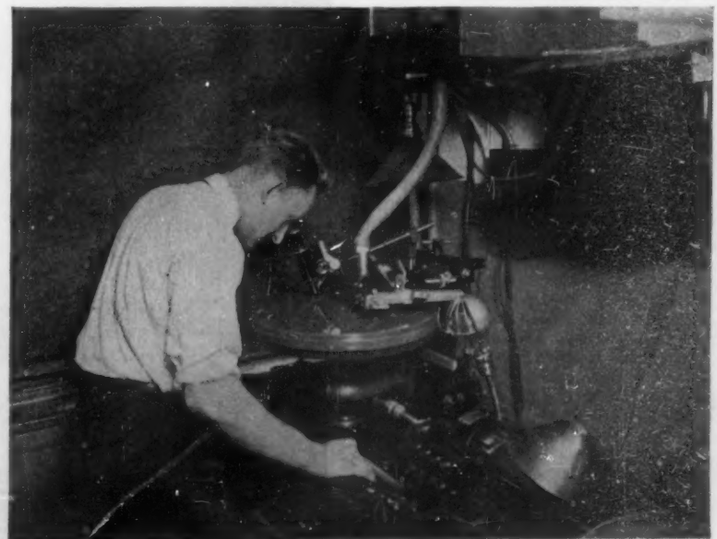
The first of these is the electrical system of recording. This method employs a high quality microphone of an improved type, electrical amplifying apparatus, and a record-cutting mechanism. Recording may be carried on at a considerable distance from the source of sound so that the actors may be grouped naturally in any scene and need not be crowded before a microphone.

The second essential feature is a remarkable electrical reproducer which converts the movements of a needle in the grooves of a sound record into electrical vibrations. The electrical currents from this device pass into an amplifier and then operate a high quality loud speaker of an improved type capable of filling practically any motion picture auditorium with sound.

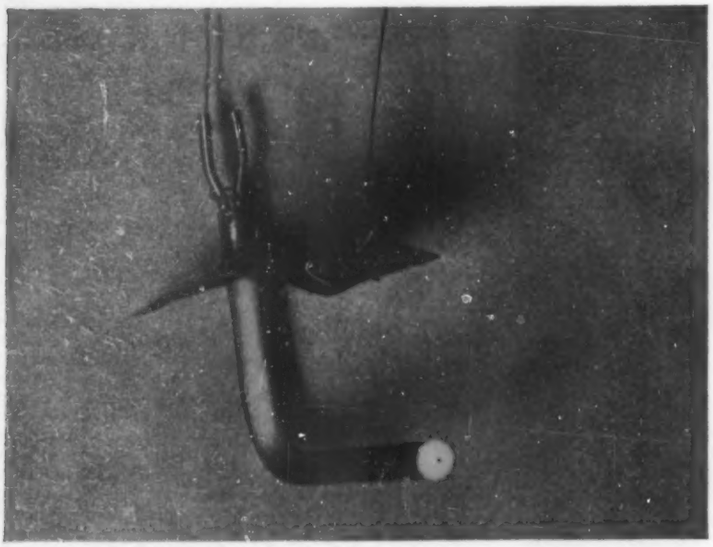
The third development is the link between the reproducer and the audience in a theatre. An adaptation of the public address system makes it possible to pick up electrical vibrations from the reproducer, amplify them, and by means of properly located loud-speaking telephones, to transform them into sound. The loudness is so regulated as to give the illusion that the source is the actors whose



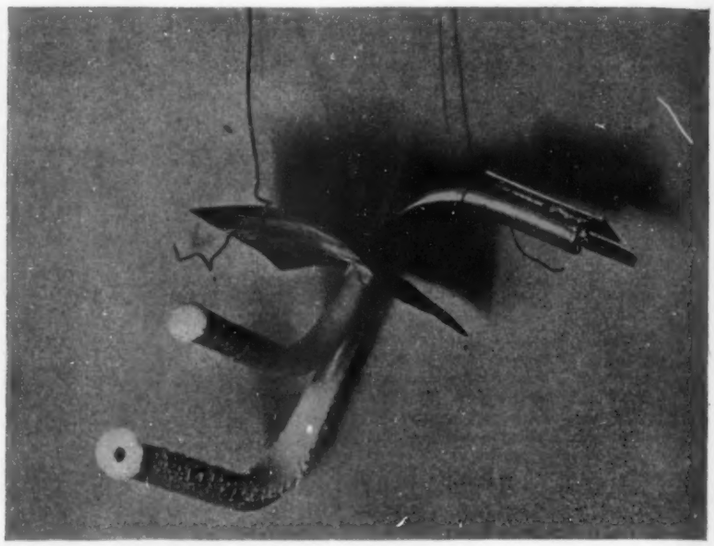
The sound-proof booth from which the pictures are projected. Were it not made sound-proof, extraneous noises would also be reproduced



The recording apparatus, showing the wax disk. The technician is shown examining the grooves in which the sound vibrations are recorded



Despite the ice which has formed on the opening of the tube, it still functions at full efficiency with only a tiny opening left unobstructed. Thus, cold weather flying is rendered more safe



Two types of tubes were tested. Gradually the ice narrows the opening but the tube must stay open as long as the airplane is able to fly with the coating of ice on the wings

pictures appear on the screen. In the case of musical programs a specially constructed loud-speaking telephone insures the correct values and naturalness.

The combination of these three factors in a complete and effective system required the development of a mechanism for keeping the film and sound-producing instrument in absolute synchronism, both during recording and during reproduction. It was essential that the system be capable of easy operation in a theatre, without requiring special skill. To meet these requirements both the film and the sound device are set in their respective machines with a given marker in the proper place, and the two machines are then speeded up from rest, together, by the simple device of having them coupled to the opposite ends of the same motor.

The mechanism for taking the pictures with these markers on the original film and record could not be provided in so simple a manner, since the camera had to be left free to be moved about on its tripod to change the angle of view. In this case two motors are used, one to drive the camera and one to drive the sound-recording machine. An ingenious electrical gearing device has been developed whereby the two machines can be started from rest and maintained in synchronism, not only after they are up to speed but during the period while they are speeding up.

In developing the system it was necessary to perfect a method of making sound records which will run at least fifteen minutes without distortion either of the high or of the low notes. Through the use of two reproducing machines used alternately, interruption of the accompaniment will be avoided. Reproduction in the theatre preserves the correct relationship of each sound to the others, the intensity varying in the same proportion as in the enacted scene or musical program.

An important use of the new system will be for providing musical programs for motion pictures already taken. This is accomplished by projecting the picture in the usual way and recording the music, as previously cued, in synchronism with the projection instead of in synchronism with the photographing. Any picture which has ever been produced can be orchestrated and synchronized. The sound synchronization is not dependent on recording at the time of the exposure of the film.

One of the difficulties of producing talking motion pictures which had been encountered in earlier attempts lay in the necessity for keeping the artists close to the recording equipment in order that a satisfactory reproduction might be made, but the new process of electrical recording makes it possible to make faithful records at a distance from the source of sound.

The most difficult part of the development was the reproduction of music or speech from the apparatus in such a manner that it would be as loud as music or speech from a real performance and at the same time would be a faithful copy in all respects. The special electrical device for converting the motion of the needle which bears on the record into electrical vibrations, and the use of a modified public address system, overcame these difficulties.

* * *

Unsung Heroes of the Air Service

FEW things could endanger the air pilot's life more than the failure of his speed indicator. Without this guide the speed of the plane might imperceptibly decrease to the danger point, producing a "stall," and resulting, probably, in disaster.

Among those who have taken peculiar risks to make aviation safe for the flyer is the man who tests aircraft instruments in a freezing rain, within a refrigerated chamber, during midsummer heat.

The particular form of experimentation about to be described was unique in that freezing temperature, rain, sleet, a biting wind and all the discomforts of a flight through a storm were experienced indoors.

The experimenter worked in a refrigerated chamber, bundled up in a fur-lined flying suit and other cold weather flying togs. Cold rain whipped across his face as he intently watched an air speed indicator in order to determine how water, freezing on the tube leading to the instrument, affected its functioning. This was just one of the problems that is frequently met with in the development of aircraft accessories, especially in connection with the delicately constructed instruments.

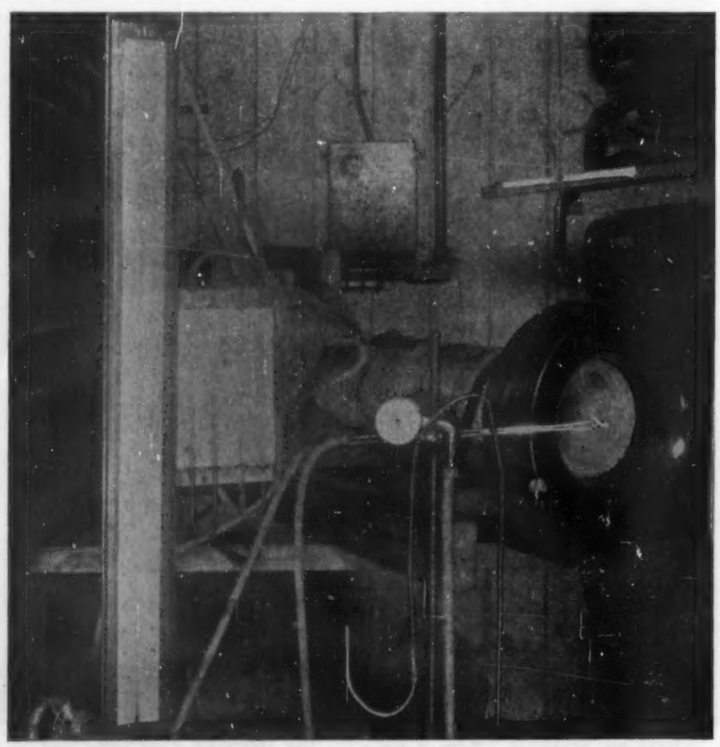
One form of speed indicator used on airplanes makes use of an open tube, into which the air blows as the airplane moves forward. The pressure generated causes the indicator to function. This tube must necessarily be mounted on a wing of the plane in the free air stream. Thus it is exposed to all sorts of weather. If, in flying through rain, the air is cold enough to freeze the water that collects at the end of the tube, the ice clogs the opening so that the air cannot pass through. The indicator then ceases to function. So the immediate problem was to study the relative merits of various types of air speed tubes from the standpoint of their effectiveness in operating when exposed to freezing rain.

A six-inch, suction wind tunnel was constructed especially for the investigation and was operated in a refrigerated chamber. In the wind tunnel the air speed of actual flight was duplicated. A vaporizer also sprayed water before the tunnel, simulating rain. To produce freezing rain, the chamber was cooled to five degrees, Fahrenheit.

For many weeks the tests continued. The tester sat before his apparatus, carefully taking readings from the indicator and intently watching the water collect and freeze on the tube. Often he would enter the test room from midsummer heat. Even during the month of July when the temperature was hovering around the 90s, he wore his fur-lined suit, heavy gloves and boots and stepped into the chilling blasts of his refrigerated laboratory. Because of the extreme exposure for that time of year, he could stay there only a limited time—usually only a half hour—never more than one and one-half hours.

Success was the reward of this more or less personal endurance test. Some sixteen different types of tubes were tried out in order to determine their functioning possibilities in freezing rain. Of this number the most satisfactory results were obtained from the tube known as the Pitot-static. This type of tube has an opening of sufficient size so that by the time it is entirely ice-covered and fails to function, the wings and the propeller of the plane are themselves so thickly coated with ice that they can no longer function. This is another way of saying that the speed indicator will continue to register as long as the plane can stay in the air.

Thus the testing of flying equipment on the ground has resulted in another discovery that will make the pilot's work more safe.



The apparatus used for testing air speed indicators. At both sides are refrigerating coils. The miniature tunnel shows in the center

* * *

Doing a Thing That Could Not Be Done

AFTER years of unsuccessful effort a way to join soft rubber directly to iron has at last been found. This will be especially valuable for attaching solid truck tires to their steel bases. Formerly a firm anchorage of a hard rubber layer to the steel was obtained by corrugating or grooving the steel and partially curing the hard rubber compound to it before the soft rubber compound was applied. The corrugations held the hard rubber and the hard rubber held the soft rubber.

The new process hinges upon the use of a specially compounded cement-like product which is applied to the metal surface in a fashion similar to the application of liquid cement. Compounded rubber is then applied directly to the treated surface and vulcanized either by heat or air. The air-cure method is followed when the application is made to wood. The process is employed as effectively on wood as on metal.

In tests, a strip of rubber one inch square and six inches long was vulcanized to a steel beam and the combined weight of two men could not tear loose the one square inch of vulcanized end. To secure such power of adhesion between metal and soft rubber is in itself a noteworthy achievement.

The hard rubber method of joining rubber to metal was expensive and often impractical, if not impossible, to employ. Naturally, there was a difference of expansion between the hard rubber and metal base. This caused cracking and separation. In the new method the soft rubber expands or contracts with the metal and its adhering qualities are not impaired by sudden changes in temperature.

Soft rubber sheet applications have already been made, by means of this new process, to steel tank cars engaged in the transportation of corrosive acids, to the interior of pipes and pipe fittings used to convey both abrasive and corrosive liquids, as lining for chutes, hoppers, fan and propeller housings, and as coverings for fan and propeller blades. In many of these installations the soft rubber has extended the life of the metal beneath it to three or four times its previous normal life.

The new process also offers unmistakable benefits to the aircraft industry. It has been tried out successfully for covering aluminum airplane propellers. Pontoons and seaplane floats, when covered with rubber by the new method become water and barnacle proof. This greatly extends the life of the frail structures which make seaplane maintenance so costly.

* * *

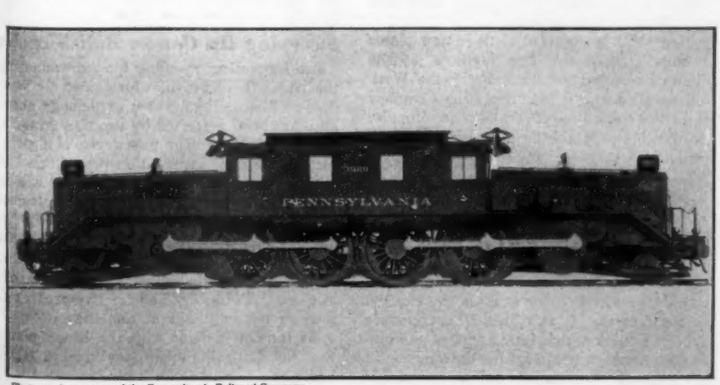
Powerful Electric Locomotive for Freight and Passenger Service

THE Pennsylvania Railroad is placing in service eight new electric locomotives to handle its heavy freight and passenger service. The design is so laid out that they may be utilized for either freight or passenger service and they can operate either on alternating or direct current by making slight modifications in the type and arrangement of the apparatus on the locomotives. When they are utilized for direct-current passenger service, as is the case in New York, they have a continuous rating of 3,730 horsepower, a starting tractive effort of 82,500 pounds, and a continuous tractive effort of 37,000 pounds when running at 37.8 miles per hour.

The passenger locomotives have what is known as the 2-8-2 wheel arrangement with the so-called "Steeple" type cab construction occupying the middle third of the length of the locomotives. In the 2-8-2 arrangement there is a two-wheel truck at each end and four coupled driving wheels between. Each pair of coupled driving wheels is connected to a jack-shaft and each jack-shaft is driven by motors which are mounted outside the frames as shown in the illustration. The connection between the motors and the jack-shaft is by means of pinions and flexible gears. The driving wheels are 80 inches in diameter.

The engines weigh approximately 400,000 pounds, of which approximately 300,000 pounds is carried on the driving wheels—the balance being supported on the two-wheel trucks at the ends of the locomotive.

These handsome machines were built complete, so far as the mechanical equipment was concerned, by the Pennsylvania Railroad—the electrical equipment being furnished by the Westinghouse Electric & Manufacturing Company, and assembled in the locomotives at the Altoona Shops.



Photograph courtesy of the Pennsylvania Railroad Company

One of the new electric locomotives which have been placed in passenger service on the Pennsylvania Railroad. It weighs 200 tons

* * *

Eavesdropping on Ethyl Gasoline

GASOLINE treated with lead tetraethyl is being studied at Massachusetts Institute of Technology in an engine in which research workers can see the process of combustion and the flames of the explosion, says *The Technology Review*.

The effect of lead tetraethyl in eliminating knocks in gasoline engines has been known for a considerable time, but hitherto little was known of what took place when the lead-treated gasoline was exploded in the cylinders.

In seeking a means of studying the action of lead tetraethyl in engines, workers in the laboratory of applied chemistry in charge of Professors G. L. Clark and R. P. Russell cut away a portion of the cylinder wall of a one-cylinder engine and replaced it with a small, heavy, quartz window designed to withstand the tremendous force of the explosions. The experiment was a success and it is now not only possible to watch the flames of the exploding mixture, but to photograph them with the aid of a revolving shutter in front of the window. A spectroscope was also used to evolve a spectrum of the light from the flames.

The first discovery in this investigation was that lead tetraethyl completely blots out the ultra-violet light rays in the detonating flames. On the basis of that discovery those in charge of the research are seeking to determine what relation may exist between engine knocking and the presence of ultra-violet light rays.

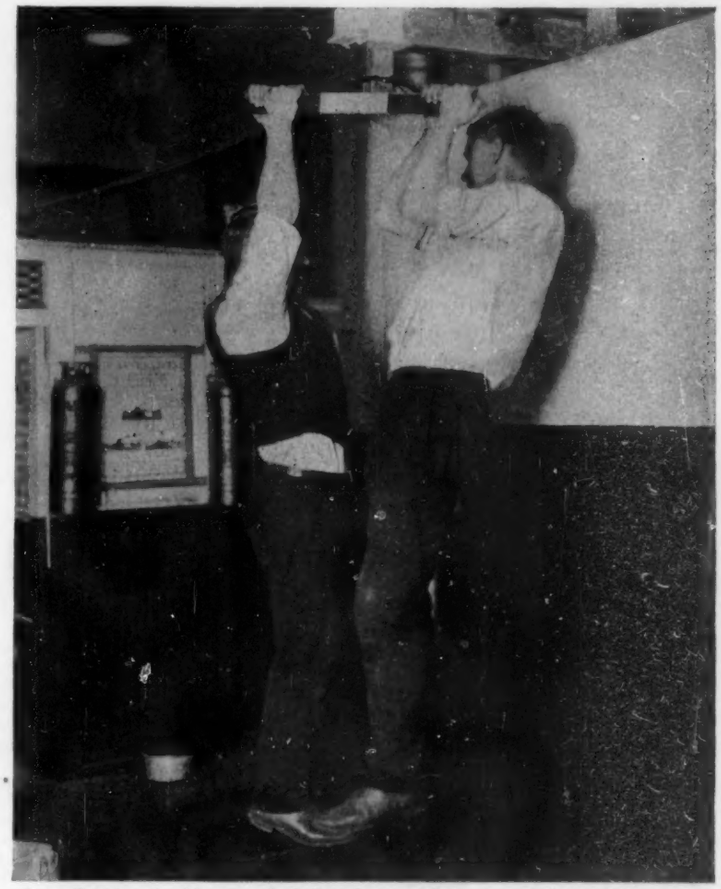
Measurement of the force of engine knocks is also being studied electrolytically. A plunger fitted in the top of the cylinder closes a circuit when a knock occurs and the length of time the circuit remains closed is a measure of the severity of the knock. The closed circuit is then used between electrodes for electrolysis of a solution of sulphuric acid of known strength. The amount of hydrogen thus produced is taken as a measure of the knock.

* * *

Two New Books on Astronomy

"ASTRONOMY Today" is the title of a book recently published by E. P. Dutton & Co., the author being the Abbé Moreau, Director of the Observatory of Bourges, France. This book is a brief survey (250 pages) of the entire field of elementary astronomy, but is not a textbook. It would both interest and instruct anyone having the desire to increase his understanding of general astronomy. Perhaps the reader who had previously covered some elementary textbook such as Todd's "New Astronomy" (the clearest, without much doubt, of them all) would obtain more from it than one who had not, yet anyone who had read it would carry away a definite, even if only a beginner's, comprehension of the whole field of astronomy.

"The Music of the Spheres," by Florence Armstrong Grondal (Macmillan, 1926), is described as "a nature lover's astronomy." If one cares to learn the constellations of the stars by the roundabout route of learning the mythology of the ancients about them, this book is one of the most attractive, both in style and production, of its kind. It also contains occasional statements of fact concerning modern astronomy, painlessly sugarcoated by poetic fancy. Not that poetic feeling is out of place in the study of astronomy. Far from it. Astronomy is itself a poem, and all the remarkable things that the science of spectroscopy is so rapidly revealing about the size and nature of the Universe are its stanzas. But this poetry is inherent in the stars, while that of the ancients was merely assigned to them.



A small strip of rubber attached directly to steel by a newly discovered process. Until recently this could not be done

* * *

Shall We Have Smallpox Again?

THE United States has the unenviable distinction of reporting more smallpox during 1925 than any other country except India, namely, 43,193 cases, according to reports which have been received by the American Association for Medical Progress from the health officers of all but one state (Utah).

Most of the states do not report the vaccinal condition in cases of smallpox. In 17 states and the District of Columbia such reports are available for most of the cases—10,636 out of the total of 12,858 cases in these states. Among these, 9,660 cases, or over nine-tenths, had never been vaccinated, and 751 cases, about 7 percent, had been vaccinated from 7 to 50 years previously.

Thirteen states each reported more than 1,000 cases of smallpox in 1925, California leading with 4,921 cases, followed closely by Alabama (4,288), and Ohio (4,018). Indiana had 2,996 cases; Georgia, 2,108; Washington, 2,004; North Carolina, 1,920; Tennessee, 1,805; Kentucky, 1,700; Illinois, 1,625; Wisconsin, 1,517; Texas, 1,309; Mississippi, 1,216. All of the six New England states together had only 102 cases, 94 of which were in Rhode Island.

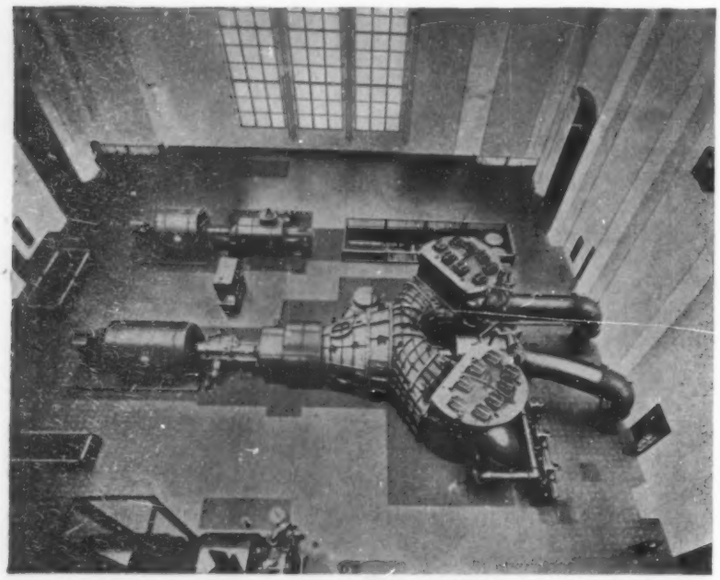
* * *

Parsons 50,000-Kilowatt Turbo-Alternator for Chicago

WE present a remarkable photograph of the 50,000-kilowatt Parsons turbo-alternator which has just been installed by the Commonwealth Edison Company of Chicago in the Crawford Avenue Station. This machine was ordered from England in accordance with a commendable policy of the Company, under which they have from time to time installed a single representative of the best European practice. The view is taken from the overhead traveling crane looking down upon the floor, and it shows in great clearness the main features of the installation.

Steam is fed at a stop valve pressure of 550 pounds per square inch and a temperature of 750 degrees centigrade, to the high-pressure turbine, which is seen on the further side of the floor. The turbine is direct-connected to a 16,000-kilowatt alternator. The steam from the high-pressure turbine is reheated and delivered to the intermediate pressure turbine (seen in the center of the nearer group), which is direct-connected to a 29,000-kilowatt alternator (shown to the left). The exhaust from the intermediate turbine passes to the low-pressure turbine.

The pipe between the intermediate and the low-pressure turbines is made in the form



A new 65,000 horsepower turbo-alternator which was recently installed at Chicago. It is one of the world's largest

of a double-walled cone—the steam flowing through the annular opening between the two walls. The exhaust from the low-pressure unit passes to two vertical condensers by means of two heavily ribbed structures.

The high-pressure turbine runs at 1,800 revolutions per minute, and here the steam is expanded from 550 pounds to 100 pounds gage. Part of the steam is led to the third-stage feed-heater, but the bulk of it is conveyed to a reheater in the boiler house, where the temperature is raised to 700 degrees, Fahrenheit; and thence the steam is passed to the intermediate-pressure turbine, which it enters at a pressure of about 105 pounds absolute, exhausting at about two pounds absolute.

Although the intermediate and high-pressure turbines are in the same axial line, they operate independently—the low-pressure turbine running at 720 revolutions per minute and driving a 6,000-kilowatt generator. In addition to reheating, the thermal efficiency of the set is increased by progressive heating of the feed water by steam bled from different stages of the turbine.

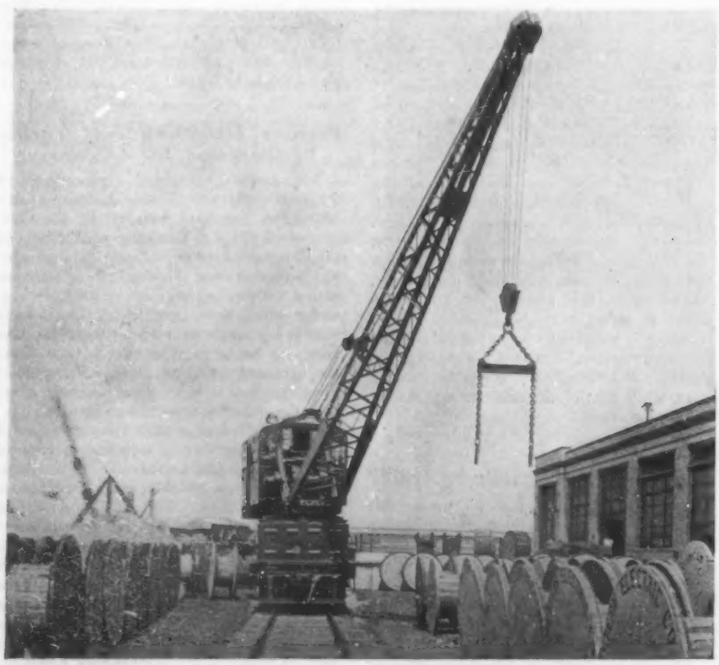
As showing the magnitude of this unit, it should be mentioned that the total steam entering the turbine is about 420,000 pounds per hour. Furthermore, because of the great expansion that has taken place, the volume of the steam delivered to the condenser is enormous, amounting to about 72,000 cubic feet per second.

Necessarily, the various parts of this great turbine run to large figures; the high-pressure element weighing 103 long tons, the intermediate pressure 147 long tons and the low-pressure element 148 long tons, making a total of about 400 long tons for the whole turbine.

When the turbine was completed at the shops of the Parsons Company there arose the problem of how best to ship the machine to Chicago. There were three alternative routes. First, by the Mississippi and the Chicago Drainage Canal; second, by the Hudson River and the Erie Canal, and lastly, by the St. Lawrence River and the Great Lakes. The Mississippi was not available because of the shallow draft, and the overhead bridges of the Erie Canal would not permit any of the barges taking packages of the size of those to be transported to pass. The Erie Canal had its drawbacks, largely connected with barging and transshipping arrangements; so it was decided that the only practical route was by way of the St. Lawrence River.

To transfer the huge packages from the ship at Sorel, Quebec, it was necessary to use the sheerlegs of the Government at their yard at Sorel, Quebec. The Atlantic passage was a rough one and every day a careful inspection was made of the packing shores and of the tightening up of wedges, et cetera. At Sorel, the bed of the river had to be dredged to enable the stern of the steamer to get alongside.

It took a week to discharge and another week to load the turbine on a lake boat, and it took a week to get to Chicago, for the boat was built to the absolute capacity of the locks with a clearance in length of about one foot and on the beam of about four inches. The heavy packages were discharged at Chicago, thanks to the difference in stowage arrangements of the holds in ocean and lake ships, in about half the time that it took to load them—the lake boat having no shelter between decks and with clear holds free of columns.



A new electric crane, driven by a storage battery which keeps the crane at work a whole day at a time

The ship was unloaded by means of one 60-ton steam crane on the wharf and a temporary set of sheerlegs built of two 80-foot long beams. Then came the journey of five to six miles by special train to the Crawford Avenue Station, which was done at a speed of about one mile an hour. The car carrying the heaviest section had to be strengthened, and the load enroute fouled the buildings. When that happened, the railway gangs shifted the bed over, until the loads were able to clear, and then swung the lines back into their original position.

This plant is the third of three new plants at this station—the first being a 50,000-kilowatt reaction turbine built by the Westinghouse Electric & Manufacturing Company and the second a 60,000-kilowatt impulse turbine built by the General Electric Company.

* * *

Something New in Traveling Cranes

AMONG the many designs of traveling cranes, the one shown in the accompanying picture is, so far as we know, unique. Its novelty, as will be seen at a glance, consists in the fact that it is driven by an electric storage battery which forms part of the outfit and therefore travels with the crane. In other words, the crane is self-contained. It is carried upon two four-wheel trucks, and immediately upon the platform are mounted massive batteries. The turntable, resting upon a central steel superstructure, is at a sufficient height to give the crane full clearance above the batteries.

The whole outfit weighs a little over 100 tons; and the machine can hoist a load of 10,000 pounds at a speed of 80 feet per minute. Power is derived from the 100-cell storage battery of 1,080 ampere-hours at 230 volts. This battery has sufficient capacity to enable the crane to do a maximum day's work without recharging. The direct-current generator for charging purposes is the shunt-wound type, 170 kilowatts, 260 to 300 volts, direct connected and driven by a three-phase, 60-cycle, 295-horsepower synchronous motor, at 1,200 revolutions per minute.

At the Kearny shops of the Western Electric Company where the crane is in service, the charging voltage is maintained constantly at 260 volts, and the charging rate is determined by the charge on the battery plates. Once a week the battery is filled with water.

The crane has a capacity to lift a 10,000-pound load in a radius of 50 feet; and this enables it to lift the heaviest reel of lead-covered cable. The crane has a traveling speed of 350 feet per minute and, when traveling light, it will rotate at three revolutions per minute. A 100-horsepower, 230-volt motor supplies the power for traveling, hoisting the boom and reeling in the bucket or hook block through several trains of spur gears. The rotating is done by a 25-horsepower, 230-volt motor. A 19,400-pound counterweight is installed in the tail of the superstructure. We are indebted to the Brown Hoisting Company, the builders of the crane, for the accompanying photograph and the data.

The cotton boll weevil exterminator at work in the field. It sweeps the weevils into poisoned pans

* * *

Sweeping Up Cotton Boll Weevils

AN interesting machine for exterminating the cotton boll weevil, which does six hundred million dollars' worth of damage annually, has been perfected by two San Antonio, Texas, inventors. The new device is a structural steel frame mounted on two wheels like a sulky hay-rake. Below the body is a long galvanized steel pan, containing an element which kills insects. On either side is an angular deflector which draws or bends the plants over the pan. On their rear portions, beaters of perforated galvanized steel, smooth as glass, are hinged. The machine treats two rows of cotton plants at one time.

As contact is made with the cotton plants the weevils fold their legs against their bodies, falling into the killing element.

As the machine advances, the plants pass

(*Continued on page 58*)

"Never!"

"YOU know very well I like you," she said, "but—"

"But what?" he demanded quickly.

"But marry you—never!" she said simply. "There's something about you that I could never put up with."

"And what's that?"

"Oh, well, let's not discuss it—at least not tonight. Sometime I may tell you—still, maybe never."

* * *

You, yourself, rarely know when you have halitosis (unpleasant breath). That's the insidious thing about it. And even your closest friends won't tell you.

Sometimes, of course, halitosis comes from some deep-seated organic disorder that requires professional advice. But usually—and fortunately—halitosis is only a local condition that yields to the regular use of Listerine as a mouth wash and gargle. **It puts you on the safe and polite side. Moreover, in using Listerine to combat halitosis, you are quite sure to avoid sore throat and those more serious illnesses that start with throat infections.**

Listerine halts food fermentation in the mouth and leaves the breath sweet, fresh and clean. *Not* by substituting some other odor but by really removing the old one. The Listerine odor itself quickly disappears.

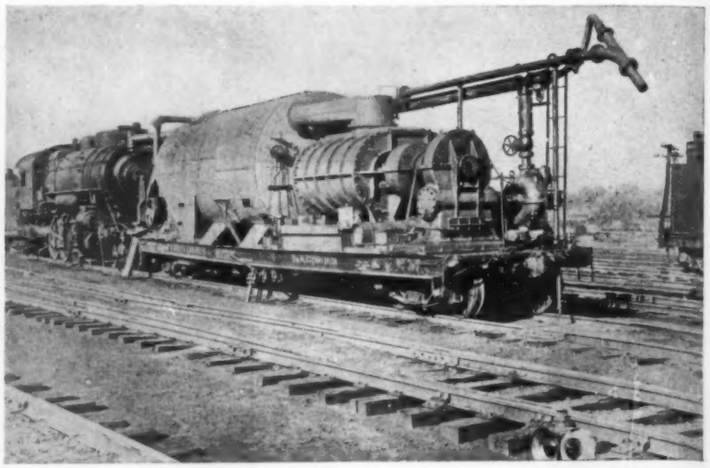
This safe and long-trusted antiseptic has dozens of different uses; note the little circular that comes with every bottle. Your druggist sells Listerine in the original brown package only—*never in bulk.* There are four sizes: 14 ounce, 7 ounce, 3 ounce and 1¼ ounce. Buy the large size for economy.—*Lambert Pharmacal Company, Saint Louis, U. S. A.*

For HALITOSIS use LISTERINE

A Challenge

We'll make a little wager with you that if you try one tube of Listerine Tooth Paste, you'll come back for more.

LARGE TUBE—25 CENTS



The new railroad ballast cleaning machine. It virtually launders the broken stone and returns it to the track cleaner than hand-cleaned ballast

from the rear of the deflectors, and are bent under the beaters. These are driven by pitmans which are actuated by cranks situated above them. These beaters give the plants four or five violent shakes. The power for moving the beaters is obtained by the tractive effort of the wheels.

* * *

Pneumatic Railroad Ballast-Cleaning Machine

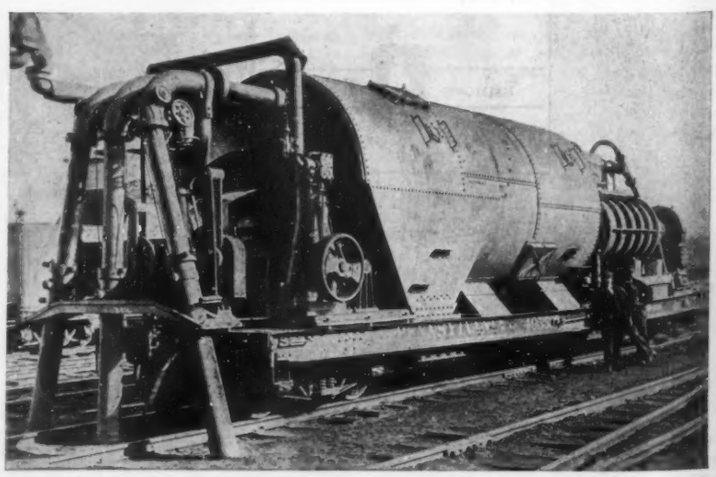
THE maintenance of the roadbed and track of a first-class railroad carrying heavy traffic is one of the most expensive items in its operation. On a new stretch of roadbed the broken-stone ballast which supports the ties is sharp and clean and offers free drainage for the rain which falls upon it. Moisture finds its way quickly to the subgrade and thence into the side ditch. But, in the course of time, the continual falling of cinders and dust upon the ballast, fills up the interstices and the mass becomes matted together, thereby preventing the free drainage of rain and snow. Periodically, it is necessary for the section gang to clean the ballast, loosening it up with pick and shovel, removing as far as possible the accumulated dirt, and replacing it below and around the ties. Because of the high cost of labor, this work and the general maintenance of way is one of the most expensive operations on a railroad.

We present two views of a simple device, by means of which the slow and expensive methods of track cleaning by hand labor will be replaced by mechanical power, with a reduction of cost of about 50 percent. The pneumatic ballast-cleaning machine, as it is called, was designed by Mr. George Ehrenfeld for the Pennsylvania Railroad Company on order, and it has been put into service on the main line of the road—about five miles east of the Harrisburg station. The equipment is mounted on a special, steel flat car built by the Pennsylvania Railroad Company, which is 10 feet wide, 48 feet long, weighs about 40,000 pounds and has a carrying capacity of 150,000 pounds. The main elements consist (right to left in the pictures) of a steam turbine, a positive pressure blower and a large cylindrical expansion chamber.

The equipment car weighs about 110,000 pounds empty, but while it is in service, it carries an additional load (temporarily) of 15 to 20 tons of ballast and refuse. Power is obtained from the locomotive (steam at 205 pounds pressure) and is carried over by a pipe line to the steam turbine, which is of 250 horsepower and runs at 2,050 revolutions per minute. From the turbine, through a flexible coupling, the turbine operates a worm-gear reduction unit which drives a positive pressure blower at 175 revolutions per minute. This blower generates a high velocity current of air at 20,000 cubic feet per minute at a velocity of 18,000 feet per minute.

The pressure blower is connected to the expansion chamber, which is 10 feet in diameter, 20 feet long and weighs 26,000 pounds. During operation there is a steady rush of air through this chamber. At its forward end are connected three steel pipes, as shown in one of the illustrations. These pipes have a lateral oscillating movement and they are arranged so as to telescope vertically. They can cover a width of thirteen feet across the roadbed. These adjustable pipes suck up the material down to a depth of seventeen inches below the surface of the rock ballast.

In operation, the first thing is to lower into the ballast the three scarifiers or steel forks which are carried on each side of the car at its mid-length. The locomotive then pulls



The ballast is sucked up through the three large pipes shown, passes through the large chamber and is returned clean to the right of way

the operating car, that is, the ballast machine, along at about ten miles per hour for as great a distance as may be desired. Then the scarifiers are drawn up to the body of the car and securely locked in position.

The next operation is to back the locomotive away from the car for a distance of twelve feet, so as to secure working clearance, and the three oscillating pipes are then telescoped down into the loosened ballast of the roadbed. Then a switch is thrown and the blower starts into action. Under the enormous suction, the rock ballast itself and the dirt, bolts, nuts, refuse, etc., are sucked up from the roadbed through the three oscillating pipes, at the rate of about 150 tons per hour, and discharged into the expansion chamber, where the rock ballast is thoroughly cleaned by air and is then discharged back to the roadbed on either side of the rails through two heavy slowly rotating air locks. The refuse is deposited temporarily in the lower part of the expansion chamber. The final operation is to draw the refuse out of the chamber and deposit it in a car attached to the rear of the work train.

When the ballast machine is in service, it is drawn slowly along the rails by two steel cables attached to the pilot of the locomotive—the ballast and refuse being meanwhile drawn up, separated, cleaned and finally returned to the roadbed at about twelve feet from the point at which it was sucked up. The complete cycle from drawing up the ballast to returning it to the track requires about twelve seconds of time, and the work of cleaning, et cetera, is performed automatically.

When it is necessary to clear the rails for traffic, the machinery is stopped, the pipes are telescoped up out of position, and the carriage carrying the pipes is drawn back into the cab, thus clearing the coupler. The cables are wound upon steel drums and the locomotive couples up to the forward part of the ballast car and takes it to a siding. The time required to clear for traffic is about ninety seconds. Two men are required on the machine and it cleans up about one mile of single track in ten working hours. The cost of upkeep is negligible, since the rock ballast is actually floated on the column of air and does not come in contact with the pipe lines unless the equipment is forced beyond its normal capacity:

* * *

Another Plan for Getting Power from the Ocean

ACCORDING to the German correspondent of *Industrial and Engineering Chemistry* (New York), a German scientist, Dr. Bräuer, has recently proposed to utilize the enormous supplies of heat latent in sea water. On the surface of the sea the temperature of the water in large areas of the tropics, as well as in certain parts of the temperate zones is at least 77 degrees, Fahrenheit, the year around, while the water remains perpetually below 50 degrees at 600 to 1,200 feet depth in the same regions.

In order to utilize this comparatively limited difference or gradient in temperature it has been suggested that carbon dioxide or ammonia be evaporated with the warm surface water. The vapor pressure thus generated would supply the force to drive some form of engine, such as a steam turbine. The exhaust would be condensed in the cold water of the depths and the gases would again be put under pressure by the warm upper layers of water. Thus there would be a continuous cycle. In principle, there is little difference between this plan and steam turbine practice, and there is no doubt as to the theoretical possibility of such a power plant.

Economically, however, the question becomes more serious. The power sources are far from the localities in which they would, at least at present, be likely to be used. One plan for transferring the energy thus generated to the centers of civilization is to produce electric current by means of it and with this to obtain atmospheric nitrogen.

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics, New York University

Metal Construction

DEWOITINE, a famous French constructor, lecturing before the London Institution of Aeronautical Engineers, makes a strong plea for metal as the only practical material for the airplane.

It is a peculiar thing that in the early stages of any engineering development, wood is always the material resorted to. The automobile is a modern and striking instance of this tendency. The reasons are not far to seek. Wood is easy to work, it requires less skill of the engineer and above all construction in wood is easy to modify. The pioneers of the airplane calculated very little, relying largely on intuition. Their plan was to build as well as they knew how, fly their machines as quickly as possible, and change them after test.

Now that technical knowledge has increased enormously, it is possible to predict almost exactly what an airplane will do. Much greater care is given to the design, but the construction changes only slightly on the trials. Therefore the ease of modification of wood construction loses its advantage.

Wood construction is also cheaper than metal construction. Particularly for the first or trial ship, the cost of the structure in wood is less than 50 percent that of the metal airplane. But in large production this initial cheapness disappears. With metal alone is it possible to use the rapid methods of modern industry.

Also, metal alone promises long life and low depreciation. Not only is wood itself subject to organic change, but wherever wood is used in the airplane, glue is likely to intervene. For example, in large wooden beams or wing spars, glue is largely used to fasten the flanges of the beam to the webs. And in a year or so the glue may entirely disappear! Wood screws alone remain to maintain the spar, and the danger in flying under such conditions is self-evident.

With wood construction there must always be a certain amount of play; tolerances must remain large. Therefore a wooden airplane requires careful, individual adjustment. With metal, tolerances are much smaller, assemblies are rigidly riveted together and *stay put*.

Further, while wood is for its weight perhaps as strong as any material we have, it is possible to build lighter in metal, because in metal we have a homogeneous, reliable substance in which far greater structural refinement is possible.

Also, with metal it is probable that fabric will entirely disappear. Thin sheet duralumin is gradually displacing fabric as a wing covering, and instead of representing so much dead weight, it may even, by skilful design, be made to contribute to the strength of the wing as a whole.

M. Dewoitine makes out a very strong case.

Aeronautical Meteorology

IT is interesting to see that the Ronald Press has published Gregg's "Aeronautical Meteorology," one of the first books in the English language dealing with this subject. The author in his preface states quite correctly that a knowledge of the characteristics of the atmosphere is indispensable to the development of aeronautics. The promoter of air lines can only guarantee schedules if he has definite data on wind and weather conditions along a proposed

Pacific & Atlantic

Chief Petty Officer Lyman Ford, one of the Navy's nerviest parachute jumpers, leaping into space from a flying plane. One grim look at distant terra firma and two thousand feet to travel, with no protection from death but the parachutes strapped to his back and stomach, does not deter him

Pacific & Atlantic

He's off, and tugging desperately at the ring at his breast that will release the parachute pack. The emergency ring and pack over his stomach is available in case the first fails to open. The photograph was made within two seconds after the jumper left the plane and shows him falling at the rate of 64 feet per second

airway, and insurance companies cannot fix premiums without similar information. To pilots the prediction of weather is of vital importance. Gregg's book is just the text to supply the essential elements of meteorology and it is clear, simple and accurate.

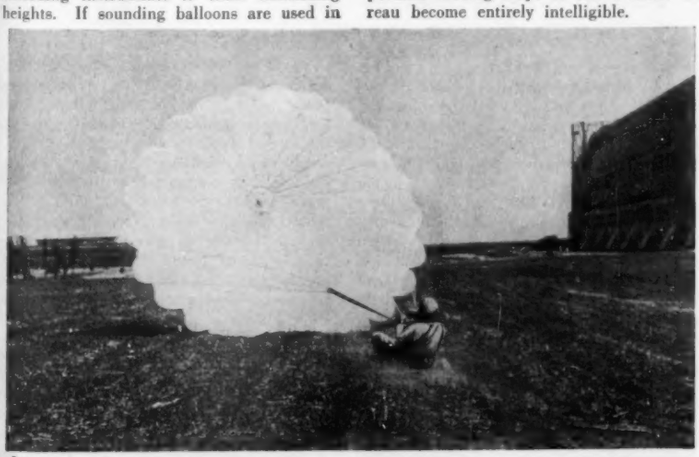
Why does the Air Mail Service maintain a faster schedule from San Francisco to New York than from east to west? Because the meteorologist has shown the prevailing winds to be such as to help the pilot on an eastward journey.

The modern meteorologist is just as interested in the upper atmosphere as he is in the conditions near the ground. Only thus does he get a comprehensive picture of the weather, and only thus can he help the aviator whose flights may be made at altitudes of 20,000 feet or more. The weather expert has been able to obtain information on atmospheric conditions at nearly ten miles above the earth's surface.

In this work real ingenuity has been shown. Sounding balloons of very light fabric, six inches in diameter when uninflated, 30 inches in diameter when inflated with hydrogen, carry a complete set of self-recording instruments to these astounding heights. If sounding balloons are used in pairs, one of the balloons finally bursts and the other brings the instruments slowly to earth. If a single sounding balloon is used, a parachute comes into play when the fabric finally fails, after having reached its maximum distention. Nothing is quite as exciting as the examination of the records of one of these aerial laboratories, which the scientists only recovers by offering a reward and clearly marking this fact on the instrument container!

It gets colder as we go up. But not indefinitely. It is a curious fact that a vertical section of the atmosphere shows a drop in temperature up to a height of seven and a half miles, to as low a point as −55 degrees Centigrade. This region is the *troposphere* and is characterized by cloudiness. Beyond this altitude the *stratosphere* shows no cloudiness and the temperature ceases to diminish. Academic in interest so far, but nevertheless fascinating to consider is this division of the atmosphere into two distinct regions.

Prediction of weather, fogs and rain becomes an intelligent possibility, if the few simple laws of meteorology are learned. The peculiar looking maps of the Weather Bureau become entirely intelligible.



Pacific & Atlantic

And then the landing. This is not as easy as it looks, for even with a parachute, the jumper is travelling at a rapid pace and the fall must be met with all muscles relaxed. When the ground is hit the jumper is wafted along in the fashion of a huge and wind torn kite

Aviation Medicine

"AVIATION MEDICINE," published by the Williams & Wilkins Company of Baltimore, is written by Dr. L. H. Bauer, Commandant of the United States Army School of Aviation Medicine and perhaps the foremost authority on this subject in the United States. It is the first complete treatise on aviation medicine ever written in the English language. This splendid book is full of interest not only for the flight physician, but for every one interested in the progress of aviation, since on the selection of the aviator and on his continued fitness depends safety in flying to so large an extent. We cannot resist quoting a few of the fascinating high spots of this book.

"A flyer who has good eyes, is sound physically, and who takes care of himself will last a good many years." Still age has a greater effect on the flyer than on men in other occupations. "Few flyers over fifty years of age will ever be found flying their own planes." Ten to fifteen years is the practical limit of a flying career.

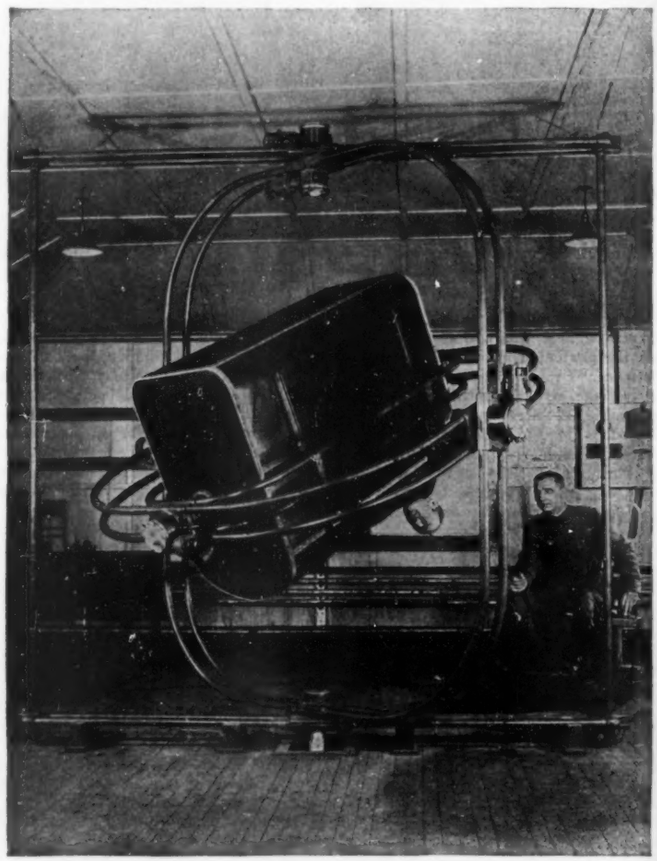
The eye is all important in piloting. Judging distance is perhaps the most important task of the eyes. "A pilot is constantly being called upon to judge distance. He does so particularly when leaving the ground, when flying in formation and again on landing. In the last instance leveling off too soon, too late, or misjudging distance from trees, buildings or other obstructions may be fatal." Many varied methods have been devised for testing judgment of distance, with adjustable rods, wires or plates of glass as the "measuring sticks." The flight surgeon has to be as ingenious as the engineer in this type of work.

Equilibrium is all important in flying where loops, barrel rolls and Immelman turns impose every conceivable position on the pilot. Eye and ear and every other means of perception come into play, and it is the combined sensations of every kind that give the brain correct judgment. The subject bristles with difficulty and controversy. It is a pity that the Ruggles orientator, developed during the war, has not been utilized in peace time. "Briefly, the apparatus consists of a cockpit of an airplane suspended in three concentric rings. It is operated by motors and is controlled by a stick and rudder in the cockpit or by a stick and rudder in the instructor's chair on the ground. By a combination of movements of the stick and rudder, the orientator can be put through any evolution that a plane can be put through, except straight forward or up and down motion.....it can be looped, rolled, spun.....These movements are similar to those made by a plane except that they are made at a greater angular speed." We are indebted to the publishers for a photograph of the orientator.

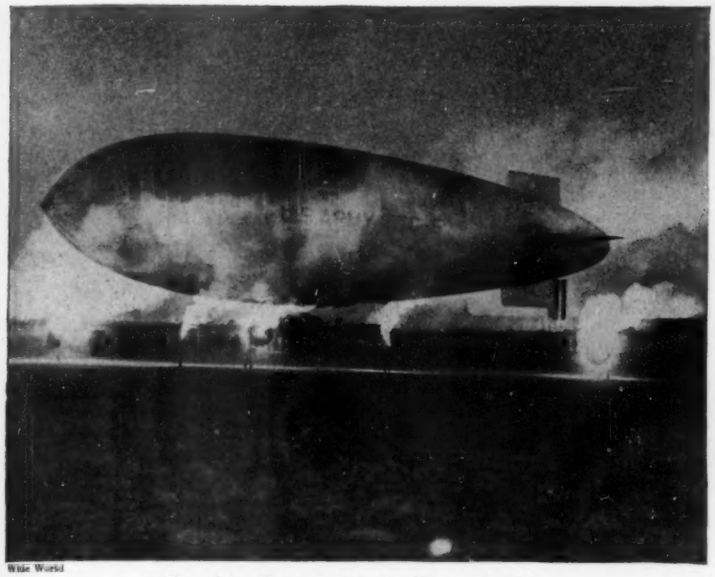
Reaction time tests and curious self-balancing tests, where the subject stands on one leg, flexes his other leg at a right angle at the knee and maintains this position for fifteen seconds, may sometimes be productive of amusement, but they are quite serious in their significance to the man who is applying for flight training in any air force.

While Macready is trying to reach altitudes of 40,000 feet with every available device at his command, it is sad to read again the story of Tissandier's famous balloon ascension in 1875. Tissandier, the sole survivor of the ascension to 28,820 feet, describes his sensations: "At 24,000 feet the condition of torpor which overcomes one is extraordinary. Body and mind become feebler little by little, gradually and insensibly. There is no suffering. There is no thought of the dangerous position, one rises and is glad to be rising." Tissandier failed to take hold of the oxygen tube, and became insensible at about 26,000 feet. His survival was a miracle.

There are, in principle, three methods of testing pilots for their ability to endure altitude conditions. "First we have the low pressure chamber. This is a steel chamber controlled by a vacuum pump which forces a constant stream of fresh air through the chamber. In simulating ascent the air is pumped out faster than it is allowed to enter and in simulating descent the air is permitted to enter faster than it is pumped



The Ruggles orientator which was developed during the late war



Wide World

Parachute flares used in landing a dirigible

out. Any altitude may be maintained as desired.....We may use a nitrogen dilution apparatus. In this the subject breathes a stream of air in which there is a steadily increasing percentage of nitrogen. The barometric pressure remains the same, but the oxygen pressure is reduced by increased percentage of oxygen. The third method involves the use of a rebreathing machine.....In this the subject breathes over and over again the same air with the carbon dioxide removed. He burns up the oxygen, thus constantly reducing the percentage." These tests sound very unpleasant, and they do not have as compensation the thrill and glory of high altitude records.

Major Bauer recalls the Pulitzer race of 1923 in which Lieutenant A. Williams became unconscious when making turns. "That he must have been is evidenced by the fact that he went round an additional time, not being sure how many laps he had completed. What is the explanation of this? It is believed the answer is centrifugal force.....As the flyer makes a turn, the pull of centrifugal force is in the direction away from the pilot's head or towards his feet.....The blood is carried away from the head to his lower extremities..... Anemia of the brain, resulting in haziness, dizziness and even unconsciousness results."

The protective devices employed in altitude flying, the duties of the flight surgeon, the medical certification of the civilian pilot are among other interesting topics dealt with in a work which deserves careful reading.

Parachute Flares

THE airplane embraces everything in its service. For night landings and night reconnaisance work, fireworks, or in more dignified language pyrotechnic displays, have been pressed into service. Sometimes flares are placed at the tips of the wings. Metal cylinders with asbestos plaster internal covering contain the pyrotechnic material which electric wires ignite very readily. The flares are placed at some distance below the wing, and the fabric covering of the wing is suitably protected.

Sometimes parachute flares are employed, placed in special racks in the plane and released by a simple Bowden wire control.

Wide World

Flares are sometimes contained in metal cylinders with asbestos plaster internal covering

The parachute flare sails safely to the ground and produces a most brilliant display in the process and for some time after landing.

Altitude Indicators

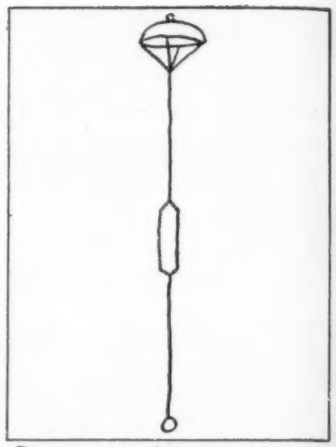
THE airplane altimeter is nothing more than a small, accurate barometer which registers the pressure of the air. A certain pressure is taken as corresponding to a certain altitude, based on standard atmospheric conditions. But weather conditions and temperature changes influence the pressure drop at altitude to such an extent that the altimeter can never indicate the exact height above the ground or sea level. Not infrequently the altimeter may tell the pilot that he is flying below the ground!

The errors involved are not so important for an airplane flying at several thousand feet above the ground. But if a plane is operating in a fog or at night, the pilot may be flying his machine dangerously low without his instrument giving him sufficient warning for safety.

Another principle than that of pressure indication has to be employed. The German physicist Behm has now developed an altitude indicator based on the principle of the speed of echoing sound, in a form entirely suitable for use aboard an airplane. When the sounding signal is given, a point of light is set in motion parallel to a vertical scale by a combination of electrical and acoustic appliances. When the echo reaches the sounder, the point of light immediately descends to its zero position. The vertical scale is graduated up to 200 feet, and the motion of the point of light accurately gages the altitude to within a few inches. The Behm sounder once set to work, can also operate automatically and give a reading at intervals of half-a-second. The instrument should prove invaluable in all cross-country flying.

For airship navigation it may also be important to know the exact height several thousand feet above sea-level. Only thus can the navigator interpret his altimeter pressure readings for meteorological purposes. Here the sound indicator becomes less useful, and at great heights the conflicting sounds always present on board an airship may cause it to become inoperative.

A correspondent of the Scientific American, Elbert N. Todd of Crisfield, Maryland, has been working along entirely different lines. A very small radio transmitter with its batteries is enclosed in a suitable vessel. An aerial wire from the transmitter in the vessel is suspended by a small parachute three to four inches in diameter. The ground wire hangs below the vessel and has a small weight on its end to keep it taut. The device is dropped from the airship by a radio operator and can be made to fall at any given speed by suitably adjusting the weight of the apparatus and the size of the parachute.



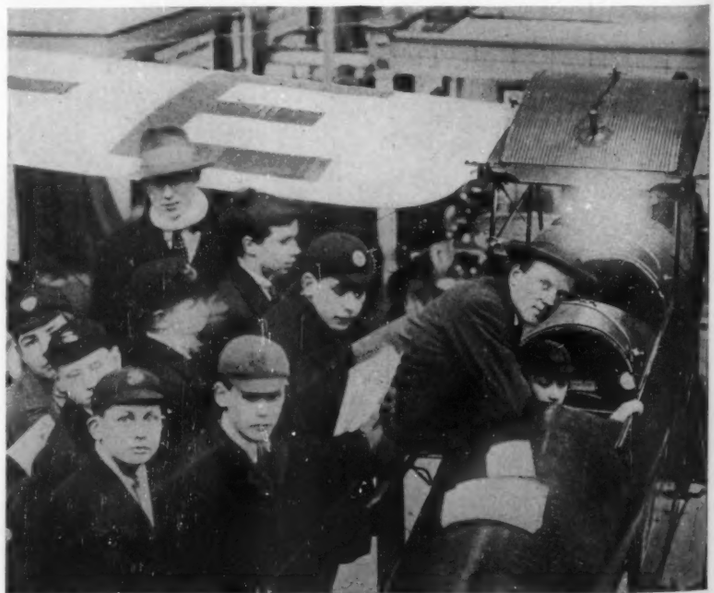
Diagrammatic sketch of the Todd altitude indicator. A small vessel incloses a wireless transmitter which gives a signal when the ground is struck. The size of parachute allows the speed to be regulated

When the sounder strikes the earth or sea, a spring contact arm, held out of engagement by the pull of the weight on the end of the ground wire, is relieved of this weight and closes a circuit. The radio signal sent out is picked up by a suitable receiver and aerial on board the airship, and from the time intervening between the dropping of the vessel and the receipt of the signal, the height is calculated.

While certain errors are possible, such as varying velocity of fall due to a possible vertical movement of the intervening air, the idea is worth serious consideration and is certainly ingenious.

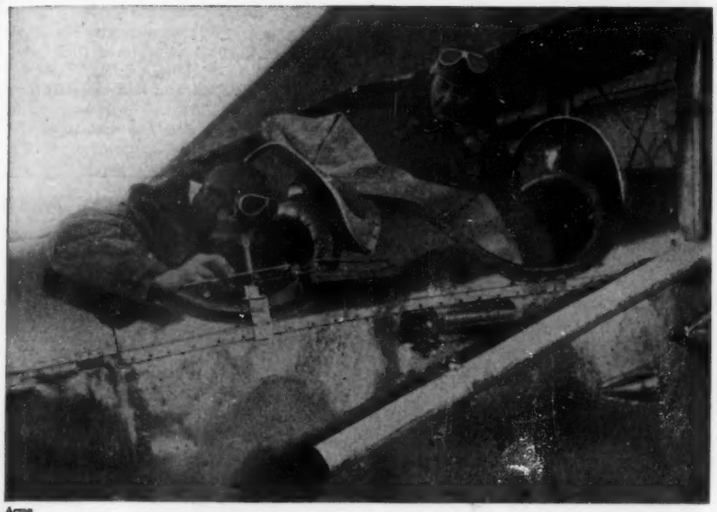
Educating the Schoolboy

THE British are thorough believers in the popularization of flying. Subsidized light airplane clubs, popular lectures in schools and other methods are employed to this end. Our photograph is evidence of this policy. The master of Sempill recently completed a thousand-mile tour of the British Isles in a De Havilland *Moth*, a most successful light plane, and is seen demonstrating the craft to a group of typical English boys at the Schoolboys' Exhibition in London.



London News Agency

The master of Sempill, an English school, recently completed a thousand-mile tour of the British Isles in a De Haviland *Moth* light airplane. He is seen demonstrating with a *Moth* at a schoolboys' exhibition held in London



Acme

Officer looking through the eyepiece of a speed and drift indicator

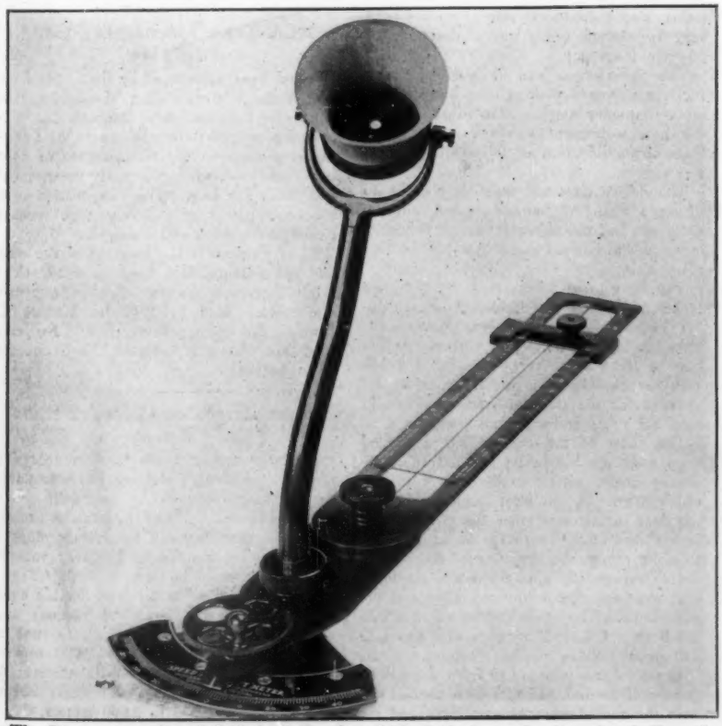
A Speed and Drift Indicator

IN a recent flight from Dayton, Ohio, to Boston, Massachusetts, Captain Bradley Jones and Lieutenant Lyman P. Whitten of the Army Air Service flew 725 miles in 350 minutes, breaking the non-stop record between these two cities. The primary object of the flight was not to break records, however, but to test a number of instruments, such as a turn indicator, an earth inductor compass and a speed and drift indicator. With these instruments cross-country navigation becomes possible even in fog or in the dark. Through the courtesy of the Pioneer Instrument Company we are able to describe in detail the latest and simplest form of the speed and drift indicator.

The base plate is mounted on the side of the airplane. Suppose that the airplane is not traveling in the direction of its longitudinal axis, but owing to a side wind is drifting sidewise. The navigator is anxious to determine the angle of drift. He rotates the vane of the instrument by the knurled disk with a short handle until objects on the earth or sea appear to travel along the longitudinal drift wire. He has then determined the angle of drift.

This is not sufficient for purposes of navigation however. The pilot must know the true speed over earth or sea. The air-speed indicator is a measure of the speed relative to the surrounding air, but if the air is itself in motion, that is if there is a wind, the air speed is *not* the true speed. To determine the true speed, the slider is moved along the vane until the movable cross-wire is at a figure corresponding to the altitude. Looking through the eye-piece, the distance seen on the ground between the two cross-wires is read on the side of the vane. This is a matter of geometry, with the markings based on simple calculations made at the time of the construction of the instrument. With a stop watch the time taken between two sighted points is accurately determined, and with a table furnished with the instrument, the true speed is at once obtained.

A pilot can learn the use of this speed and drift indicator in a few minutes, and he never disregards it afterwards. There is but one error involved and that is in the altitude, since the altimeter gives an altitude based on the pressure of the air, and this may vary with atmospheric conditions. But this error does not vitiate the general value of the method.



The Pioneer speed and drift indicator by which drift from the direction indicated by the nose of the plane, and the true speed over the earth can be measured

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

Stewart Brothers

A six-tube neutrodyne set used in this location was found to deliver very good results. In a cave at Manitou, Colorado, 7,500 feet above sea level, using one hundred feet of wire for an aerial, stations 1,000 miles away were received

Latest Development in Power Amplifiers

A NEW development in the field of power amplification for radio reception has been introduced by the Pacent Electric Company. The device is known as a "powerformer" and in addition to supplying tremendous amplification it operates in connection with the 110-volt, 60-cycle house lighting mains and eliminates the necessity for "B" batteries. The engineers have succeeded in eliminating the hum caused by the alternating current and there is no fluctuation in signal strength even with a variation in voltage of 10 percent either way. Likewise the frequency can vary five percent either way of the standard 60-cycle frequency.

The powerformer can be used with any receiver equipped with at least one stage of audio-frequency amplification in which case the new instrument serves as the second stage of amplification as well as the "B" battery supply.

The device does not make it possible to dispense with "A" batteries, used with the radio set, but the powerformer furnishes its own filament current and all the "B" battery voltage.

The instrument measures 8 by 8 by 10 inches and weighs 32 pounds. A metal cabinet houses the transformers, choke coils, filter condensers, tubes and wiring. At the rear of the case there is a recessed panel, with the binding posts for the various "B" voltages for the detector, radio and audio amplifier tubes and a ground connection.

The front of the cabinet has a hinged drop door which can be lowered to a 45-degree angle, giving ready access to the unit's tubes. A red pilot lamp just below the door indicates whether the powerformer is "on" or "off." There are no adjustments to make except the snapping of the control switch on or off, and there are no parts that wear out except the two tubes and the pilot lamp. The tubes consist of one UX-216-B or a CX-316-B rectifier and one UX-210 or a CX-310 power amplifier.

Great volume is obtained from the powerformer, if desired. In fact with normal signals the radio-frequency amplifiers and detector of the receiver are turned down to a dim glow and whatever volume control is desired is accomplished by the rheostats regulating the current supply to the filaments of the tubes in the receiving set. In the case of a regenerative set the regenerative or tickler control acts as a handy volume regulator. On local reception the powerformer may be used in conjunction with only the detector to give sufficient volume for a large size room.

The advantages of the device are: tremendous volume from two-tube sets with minimum distortion; elimination of "B" batteries; clear and loud amplification from all receivers.

RCA Take License for Cone Speaker

IT has been announced by the Lektophone Corporation of Jersey City, New Jersey, that the Radio Corporation of America has purchased a perpetual license to use the Lektophone patents in the manufacture of cone type loudspeakers for a cash payment of $200,000. The Lektophone Corporation owns the basis patent of the cone type speaker issued to Hopkins and Farrand.

C. L. Farrand is the inventor of the cone and his patents date back to 1918. The original patents for the diaphragm reproducer were filed in 1913 by Marcus C. Hopkins, for use in phonographs. Five years later Mr. Farrand perfected the device for radio purposes.

Interchangeable Coils for Short Waves

INTEREST among radio fans in reception of short wavelength stations has stimulated several manufacturers to introduce interchangeable coils. These inductances are designed so that they can be quickly plugged into a socket similar to the way vacuum tubes are inserted in sockets.

One designer offers a set of flexible coils, which require three standard vacuum tube sockets installed in the circuit, to tune in all wavelengths from 30 to 2,000 meters. The coils range from 30 to 109 meters; 40 to 180 meters; 100 to 300 meters; 224 to 555 meters, and 555 to 2,000 meters.

The coils of another manufacturer receive from 50 to 1,800 meters. These inductances

require a special six-contact socket so keyed that a coil cannot be inserted incorrectly.

The third manufacturer has developed a short-wave interchangeable coil system which can be mounted readily on the radio fan's present broadcast receiver. It consists of three coils, each unit comprising a grid and plate inductance. A suitable base is provided on which is mounted an adjustable primary coil, the coupling of which may be set for best results with long or short antenna. The coils are mounted on bakelite strips. The windings are bare copper.

Swiss Have Trouble from Power Lines

SINCE the war, Switzerland has practically completed the electrification of its railway system. Nearly every town of any size has its electric tramways and most houses have electric light. The water power resources are being developed rapidly and current at voltages up to 60,000 is now carried over considerable mileage by overhead cables. The network of wires caused so much induction that it was found necessary to bury all telephone trunk lines and now the interference from the high power lines, electric railways and tramways is causing great interference for broadcast listeners. Another adverse condition radio has to contend with in Switzerland lies in the topography of the country. High mountains and deep narrow valleys dot Switzerland with "dead" spots. Despite these drawbacks, however, the Swiss are forging ahead with their broadcasting system. Three stations are now in operation and two more are planned. It is reported that vacuum tube receivers are rare, but crystal sets can be counted by the thousands, especially in Zurich and Geneva, centres of broadcasting. The Zurich transmitter is said to be one of the finest in Europe.

How to Prevent Motor Interference

THE Canadian Research Council recently completed an investigation relative to the causes of interfering noises in radio sets and suggestions for their elimination have been compiled for broadcast listeners.

A series commutator motor causing a surge by sparking at the brushes may have its leads reversed to reduce the interference it creates for near-by listeners. Where one wire is grounded, interference from such a motor is sometimes eliminated by reversing the leads supplying the motor, so that one of the brushes is connected to the ground side of the line and the field coil is connected to the live side of the line. In this case, the field coil is used as a choke. It may also be necessary to place a condenser of one or two microfarads' capacity across the brushes.

In cases where neither side of the line is grounded, a choke may be inserted on the line connected directly to one of the brushes, while the field coil may act as a choke on the other line. In this case, it is recommended to use two two-microfarad condensers in series and ground the middle point.

In cases where it is not convenient to make connections with the brushes of a motor, the condenser may be placed across the line as near the motor as possible, and a choke coil may be inserted in the live line when necessary. The live side of a low-voltage lighting circuit may be determined by means of a test lamp connected from the ground, first from one wire and then to the other. The lamp will light when connected from the live line to the ground.

Metal and Parchment Used in Diaphragm

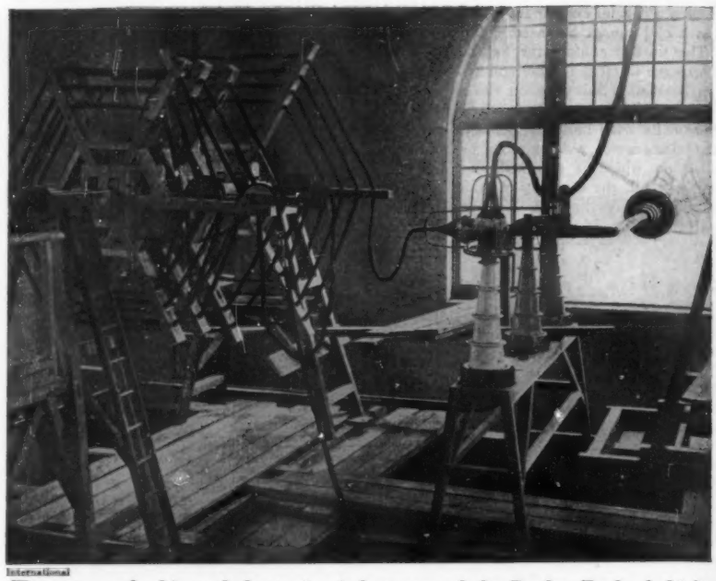
DR. Herman Fisher, acoustical engineer of the Tower Manufacturing Company, recently introduced a new loud speaker diaphragm built on the principle of a violin.

In his study of the violin he learned that the solid backpiece of the instrument varies in thickness throughout its area. It is thicker in the centre and directly opposite the bridge than it is at the edges. The backpiece of a violin, according to Dr. Fisher, is shaped by expert hands, men who become artists in giving the wood the proper graduations; and from its thickest point in the center, it tapers off until, at the edge, its thickness is reduced by more than one-half.

The principle underlying this practice is that a thicker wood will vibrate more slowly

Kadel & Herbert

This device for recording radio music and speech in permanent form for future reference or for record has recently been devised by Francis R. Hoyt whose radio inventions and writings are well known to the radio public



International

The antenna lead-in and the tuning inductances of the Rugby, England, high power radio transmitting station can be seen above. The inductances are wound on wooden arms and are adjustable in their relationship to each other for tuning

than thin wood, and when the backpiece is of different thicknesses the perfect vibration of all tones is achieved. The thick part of the wood, vibrating slowly, brings out the low violin tones to their fullest and richest extent, while the thinner surface throws back the higher tones, with nothing lost in the recording. This result illustrates the fact that the backpiece of the violin is the part that in reality registers violin tones—not the top piece, nor the bridge nor the strings themselves. It is on this principle employed in the construction of the backpiece of a violin that Dr. Fisher has modeled the new diaphragm. It is of different thicknesses, being thicker in the centre and thinner toward the edges.

The new diaphragm is made of parchment and metal. The thin parchment records the high tones and the metal, the low tones. The parchment-metal combination is thick in the center and thinner at the sides, designed to give proper balance to high and low tones.

Plan of 1842 Still Good

TRANSMISSION of pictures by radio is based upon a discovery made by Alexander Bain, an English Physicist, in 1842 according to Captain R. H. Ranger, inventor of the transatlantic photo-radio system.

Captain Ranger pointed out in the Proceedings of the Institute of Radio Engineers that Bain first proposed a device to send pictures from one place to another by electric wires. He said, "Bain's plan is so basically correct that it is only right to mention it and to show how generally we are following in his footsteps."

Bain had two pendulums, which were arranged electrically in such a manner that if one preceded the other by a slight amount of the time of a stroke it was held until the other had reached the same position, when both then began a new stroke. These swinging pendulums were the basic synchronizers which are necessary in the transmission of pictures by wire or radio.

On each swing of the pendulums, a tablet descended a notch at a time at the side of the pendulum. At the transmitting station the swinging arc of the pendulum carried a small contactor which rode over the type faces, making the appropriate electric contacts to be sent to the distant receiver where a similar swinging pendulum was tracing the path across a piece of paper. By chemical action, the electricity received from the transmitter would discolor the paper to give an impression of the original.

Captain Ranger explained that these are the basic elements of all radio pictures. First, the synchronous action covering a surface point by point at both transmitter and receiver and second the electrical identification of the points traced out at the receiver.

Under 50 Meters

SHORT-wave stations are increasing in number as are the owners of receivers designed to pick up the waves traveling through space below the 100-meter channel. The following list of transmitters operating on waves less than 50 meters has been compiled for their convenience.

Call.	Location.	KC.	Meters.
POF	Nauen, Germany	22209	13.5
2XS	Rocky Point, N. Y.	20082	14.93
2XAW	Schenectady, N. Y.	19988	15
2BR	Chelmsford, Eng.	19988	15
POF	Nauen, Germany	18738	16
NKF	Anacostia, D. C.	18738	16
2BR	Chelmsford, Eng.	17636	17
POF	Nauen, Germany	16657	18
2XAD	Schenectady, N. Y.	14991	20
KFVM	S. S. Idalia	14991	20
POF	Nauen, Germany	14991	20
NAL	Washington, D. C.	14991	20
NEPQ	U. S. S. Relief	14991	20
NKF	Anacostia, D. C.	14414	20.8
WIK	N. Brunswick, N. J.	13628	22
2YT	Poldhu, England	11993	25
POY	Nauen, Germany	11993	25
FW	Ste. Assise, France	11993	25
NKF	Anacostia, D. C.	11758	25.5
AGA	Nauen, Germany	11532	26
PCMM	Kootwijck, Holland	10903	27.5
POW	Nauen, Germany	10708	28
2XI	Schenectady, N. Y.	9994	30
NAL	Washington, D. C.	9798	30.6
2YT	Poldhu, England	9369	32
ANE	Malabar, Java	9369	32
NAJ	Great Lakes, Ill.	8630	34
WQO	Rocky Point, N. Y.	8560	35.03
PCMM	Kootwijck, Holland	8328	36
PCUU	Kootwijck, Holland	7890	38
KFVM	S. S. Idalia	7496	40
NAS	Pensacola, Fla.	7496	40
NAJ	Great Lakes, Ill.	7496	40
NPG	San Francisco, Cal.	7496	40
NRRL	U. S. S. Seattle	7496	40
NQW	U. S. S. New Mexico	7496	40
2XAC	Schenectady, N. Y.	7496	40
NKF	Anacostia, D. C.	7260	41.3
2XAF	WGY, Schenectady	7160	41.88
5XH	New Orleans, La.	7139	42
FW	Ste. Assise, France	7139	42
WIZ	N. Brunswick, N. J.	6970	43.02
WQO	Rocky Point, N. Y.	6814	44
KZA	Los Angeles, Cal.	6814	44
KZB	Los Angeles, Cal.	6814	44
PCLL	Kootwijck, Holland	6518	46
WHD	Sharon, Pa.	6119	49
NPM	Honolulu, H. T.	6119	49
2XAD	Schenectady, N. Y.	5996	50
SAJ	Karlsborg, Sweden	5996	50

New York to See Two Radio Shows

Two radio shows are scheduled to be held in New York the week of September 10-17; the Radio World's Fair at Madison Square Garden and the National Radio Exposition at the Grand Central Palace. It is the opinion in radio circles that this will be the last year to witness two radio shows staged in New York at the same time.

The National Radio Exposition Corporation organized by leading manufacturers for the purpose of conducting radio shows issued the following statement to its stockholders: "It is generally agreed that the holding in certain cities of competing shows by rival promoters is a serious burden on the industry. This situation is particularly acute in New York, where for several years competing shows have been held. The directors are confident that after this year there will be only one radio show in New York."

Protective Rules for Radio Sets

THE National Board of Fire Underwriters has a set of rules for the installation of radio antennas and protective devices.

The regulations stipulate that the lead-in wire must be of copper, approved copper-clad steel or other metal, which will not corrode excessively, and in no case shall the wire be smaller than No. 14 B&S gage, except that bronze or copper-clad steel not less than No. 17 in size may be used.

"Each lead-in conductor shall enter the building through a non-combustible, non-absorptive, insulating bushing slanting upward toward the inside, or by means of an approved device designed to give equivalent protection.

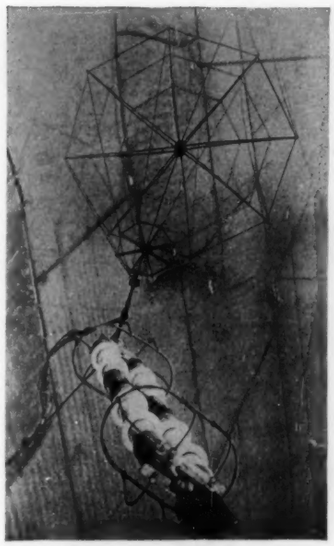
"Each lead-in shall be provided with an approved protective device (lightning arrester) which will operate at a voltage of 500 volts or less, properly connected and located either inside the building or at some point between the entrance and the receiver which is convenient to a ground, or outside the building as near as practicable to the point of entrance. The protector shall not be placed in the vicinity of easily ignitable stuff, or where exposed to inflammable gases, dust or flyings of combustible materials."

The ground wire may be bare copper, bronze or approved copper-clad steel and should not be smaller than No. 14. The ground wire running from the lightning arrester to the earth should run in as straight a line as possible to a good permanent ground.

Preference is given in the rules to the cold water pipe. Other permissible grounds are grounded steel frames of buildings or other grounded metal work in the buildings,

Wide World

David Loewe is here shown demonstrating a new vacuum tube developed by his brother, Dr. Sigmund Loewe, a German inventor



International

This view was taken from one of the masts of the Rugby station and shows the aerial insulators and the cage aerial

and artificial grounds such as driven pipes, rods and plates. Gas pipes should never be used for radio earth contacts.

The protective ground wire should be guarded where exposed to mechanical injury, and an approved ground clamp should be used where the ground wire is connected to pipes.

The rules state that the protective ground wire may be run either inside or outside the building, but wires inside the building must be securely fastened and should not come nearer than two inches to an electric light or power wire not in conduit, unless separated therefrom by some continuous and firmly fixed non-conductor, such as porcelain tubes or approved flexible tubing, making a permanent separation. This non-conductor shall be in addition to any regular insulation covering the wire.

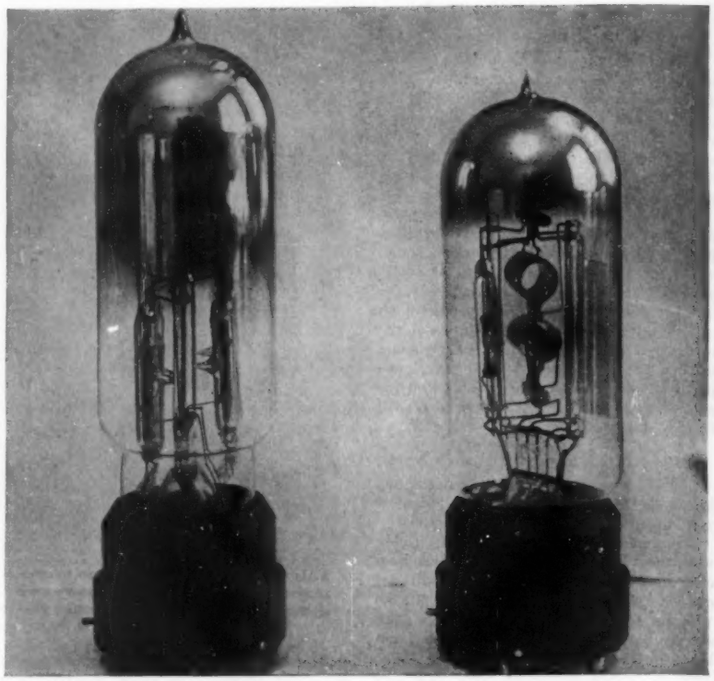
The function of a lightning arrester is to drain the accumulated static charges off the antenna and according to the rules the atmospheric electricity may be led down to the earth through the cold water pipe or radiator inside the house. However, it is recommended that the lightning arrester be placed outside the house so that the ground wire from the arrester will run in a straight line to an earth connection outside the house. A pipe driven in the earth can be used as this ground.

German Tubes Differ from American

A NEW type of vacuum tube has been invented by Dr. Sigmund Loewe of Germany. The underlying basic element of the new multiple tube is a resistance sealed in an evacuated glass tube. The resistances consist of glass rods with welded connections, on the surface of which there is deposited a fine metallic compound film, which serves as the resisting element. It is all enclosed in a highly evacuated glass tube. This resistance is said to be positively free of capacity and therefore will not retain any electrical charge. The resistance remains constant and will not vary with temperature.

The multiple radio frequency tube contains two or three grid units and it is contended that this has made it possible to overcome the difficulties of resistance coupled radio-frequency amplification together with the fact that the tube uses a double grid system having a very low internal ohmic resistance. Furthermore, on account of the fact that the units are located so closely together, the leads are very short, thereby reducing the capacity effects.

Inside the main tube there is also a smaller tube containing a mica coupling condenser, so that gases from the mica cannot destroy the vacuum of the main tube.



Two different forms of the newly devised multiple radio vacuum tubes are shown above. The tubes comprise complete detecting and amplifying circuits

The large tube is one glass bulb with four smaller bulbs encased.

It is contended that the audio frequency tube will permit a voltage amplification more than 1,500 times on frequencies between 50 and 10,000. The one tube contains a radio-frequency amplifier, detector and one power amplifier combined. Selectivity of the circuit in which the tubes are employed; high amplification and a guaranteed life of 1,000 hours are the features of the tubes. They are not on the American market but it is understood that an American company may be granted a license to manufacture the tubes in the United States.

Voltmeter to Test "A" and "B" Batteries

A DIRECT current voltmeter, a portable instrument, designed especially for use with radio receiving sets and known as type DO-3, has been introduced by the General Electric Company. The instrument has a double scale, zero to 7.5 and zero to 150 volts, which combinations are most suited for measuring filament and plate voltages ("A" and "B" batteries).

Each instrument is equipped with a set of 18 inch leads with terminals and the device can be mounted on the panel of the receiver or used portably. It will probably be more useful as a portable instrument.

Weather and Radio

INVESTIGATIONS of radio wave propagation by engineers at WGY show that the signals are better 600 miles from the transmitter than they are at 300 miles. It was found that signal strength drops off rapidly during the first 300 miles but is stronger at a receiver 600 miles distant. Beyond the 600-mile limit the signal strength gradually weakens. The engineers explained that these distances are not definite values but averages from a large number of reception reports.

A study of the zones in which fading occurs shows that it is worst between 200 and 500 miles from the transmitting station. Therefore, broadcast service is more reliable at 600 miles than at 300 miles because fading is less and the volume is slightly increased. Reception reports indicate that the rate of fading increases steadily as the wavelength grows shorter.

Furthermore, the investigations indicate that the relationship of barometer pressure and temperature with radio conditions is not definite, or if it is definite, that it is so complex that it is not yet understood. Temperature seems to have no effect upon the signals, although static increases as the temperature rises, especially in summer.

The barometer pressure seems to make little difference in signal strength when both transmitter and receiver are at the same pressure. When transmission is from a high to a low pressure area, transmission is best at short and at long distances, but at a medium distance of 600 miles it is best from an area of low to an area of high pressure.

Latest Power Tube

THE UX-171 has been introduced as a new power tube for use in the last audio stage of storage battery operated receivers. The filament current is controlled by a 5 or 6 ohm rheostat and can be operated from a 5-volt alternating current supply. The maximum plate potential is 180 volts; negative grid bias or "C" battery should be 40.5 volts for the full 180 volt "B" battery. The approximate plate current in milliamperes is 20.

The output from this tube is so powerful that it is imperative that a transformer or choke and condenser be placed between the tube and loudspeaker. It is recommended that the plate current be delivered through an audio frequency choke of from 10 to 30 henries. A 2 to 6 microfarad condenser is then connected in one lead of the loudspeaker and the other loudspeaker lead goes to the "B" battery side of the choke. If preferred the output may be delivered to the primary of a 1 to 1 output transformer, the secondary of which is connected to the loudspeaker. In either event the direct current from the tube will not flow through the loudspeaker. The function of the transformer is to insulate the loudspeaker from the high voltage used in the plate circuit. Only the desirable alternating current component will be passed to operate the loudspeaker. This tube has the new standard UX-base.

UX-200-A Is Latest Detector

THE UX-200-A is a new and more sensitive detector tube developed by the Radio Corporation of America. It operates in connection with a six volt storage battery and a "B" battery of 45 volts. The filament current is .25 amperes and the plate impedance is rated at 28,800 ohms. A ten ohm rheostat, two megohm grid leak and a

.00025 mfd. grid condenser are recommended for use with this tube. It is of the same general design as the UX-201-A.

Eavesdropping on the Brain

DR. E. D. ADRIAN, of Cambridge University in a paper read before the Physiological Society in England suggested the possibilty of eavesdropping on the human brain by means of radio instruments, in which vacuum tube amplifiers play an important part.

Dr. Adrian said that he believed that within the next few years it should be possible to read the main types of brain messages passing down from the brain via the nerves to the muscles. The passing of the messages down the nerves seems to cause an electrical disturbance and Dr. Adrian's apparatus records on a rapidly moving photographic plate the impulses along a single fibre. He "decodes" the nerve impulse by segregating a single fibre of the system.

It was pointed out that the sense organs in the skin which register temperature, touch and pain are too close together for easy segregation but the fibres in the muscles are farther apart and can be used as a link between the brain and the radio recorder.

New Traffic Manager

F. E. HANDY of Augusta, Maine, is now Traffic Manager of the American Radio Relay League, having succeeded F. H. Schnell, who resigned to pursue an experimental career.

Composers Say Radio Reduces Royalties

TOLL broadcasting, sponsored by advertisers, has not reached a paying basis, according to W. E. Harkness, an official of WEAF, in a statement made at the hearings on the radio bills before Congress. He said that the American Telephone & Telegraph Company hoped to show a profit from broadcasting this year.

During his talk Mr. Harkness said that the broadcasting of a certain play in New York increased the box office sale by 3,000 tickets. John McCormack singing over the radio brought in 60,000 orders for a single record and a WEAF client received 500,000 letters from listeners in connection with a popular radio feature.

Gene Buck, President of the Society of Authors, Composers and Publishers said that radio had caused the sale of sheet music to drop fifty percent.

John Philip Sousa said that his royalties had been greatly reduced because of radio. His first published work attained a maximum monthly income of $60,000 in royalties before the days of the phonograph and radio but in 1925 his income from royalties dwindled to $29,500. The bandmaster blamed radio for the reduction.

Neutrodyne Patent

A PATENT covering an arrangement for eliminating magnetic coupling between any number of coils in an electric circuit by mounting the coils at a specific angle with respect to each other has been issued to Professor L. A. Hazeltine by the United States Patent Office. The number of the patent is 1,577,421 and is the fourth in the series covering the Hazeltine neutrodyne inventions. Ten claims are allowed in the patent.

Cone Equipped with Soundboard

A CONE type loudspeaker equipped with a soundboard has been introduced by the Stromberg-Carlson Telephone and Manufacturing Company. The soundboard is in the form of a wide wooden ring upon the inner edge of which the cone is built. The engineers contend that the wooden ring is designed especially for vibrating at audible frequencies and therefore adds a fullness and timbre to the lower notes. The instrument is made in the form of a tip-top table, the cone and soundboard imitating the top surface when in the horizontal position. The speaker is mounted on a pedestal with legs.

An extra long cord, twenty-feet in length enables the use of the loudspeaker some distance from the receiver.

The S. S. Hamburg is now equipped with the latest type of vacuum tube transmitting apparatus. With it, it is possible to maintain long distance communication, either by means of C. W. or radiophone. Note the foreign vacuum tubes

Creation?

In the May issue of the Scientific American, page 310, Professor William D. MacMillan of the Department of Astronomy, University of Chicago, published an article entitled "The New Cosmology," in which he outlined a great cosmological cycle. Stars radiate their energy away into space, he believes, and this energy evolves elsewhere into atoms; new stars are thus ultimately formed. The significance of the MacMillan cycle, if its truth can be established, would be that the universe is not, after all, running down to cold extinction, as many cosmologists believe.

Dr. J. A. McWilliams, Professor of Cosmology at St. Louis University (St. Louis, Mo.), comments on Professor MacMillan's article in a letter, which we subjoin, together with the reply of Professor MacMillan.

Editor, Scientific American,
Dear Sir:

"The New Cosmology" by Professor MacMillan, in your May number, must surely have aroused comment. Speculations about how the world may reconstitute its available energy are always fascinating, and Professor MacMillan makes out an interesting case for his theory. For some time past the transformation of ponderable matter into energizing ether, though scarcely supported by any direct evidence as to the fact, has proved to be one of those conjectures that captivates the mind. Professor MacMillan takes the next step; he postulates the reconversion of energizing ether back into ponderable bodies, even into highly organized atoms.

My personal reaction to all this is, that although it is conceivable that a world may be a perpetual-motion machine, there do not appear to be any reliable indications that this particular world is such. The basis of Professor MacMillan's theory seems to be that "Atoms are certainly being evolved somewhere." The "somewhere" is not important. But to say that they are *certainly* being reconstituted is asking us to go rather far with him in his enthusiasm for his theory. The readers of the Scientific American would, I believe, be interested in having the data that atoms are reconstituted anywhere.

Certainly it should be a great discovery if the world were shown to be continually restoring itself in cycle after cycle. But what the Professor has in mind by his allusions to creation, I confess I cannot see. Surely he cannot mean that the conversion of ether into atoms is a case of outright creation. And his rendition of what our grandfathers held about the six days required for the genesis of the world is hardly *à propos*, for St. Augustin considerably antedated our grandfathers, and he with many others of his time allowed indefinite eons for the formation of the world.

I do not contend that Professor MacMillan's theory is impossible of verification. Its verification would be only a greater manifestation of the intricate and stupendous way in which the world is designed to carry on. But that its verification would make original creation and designing unnecessary, is impossible to see. The extension of the world's existence over countless eons does not in the least affect the evidence of creation, and reinforces that of design. I do not mean that Professor MacMillan infers the contrary conclusion. Purely physical science, as he rightly says, has no way of dealing with creation. Physical science starts with the world as a datum, without going into the antecedents of the very material world itself. However, his allusions to creation may, I fear, mislead an unwary reader as to their import, and are thus my excuse for offering for your "Editor's Mail" these few comments.

Sincerely yours,
J. A. McWilliams,
Professor of Cosmology.

Professor MacMillan's reply to the letter printed above follows:

Editor, Scientific American,
Dear Sir:

If Professor McWilliams will be good enough to refer to my paper in the *Astrophysical Journal* of July, 1918, he will find that the idea of the regeneration of matter was not the "next" step, as he calls it, but was the first step in the sequence of my ideas; the idea of the degeneration of matter, as a matter of fact, was the second step. The second step has received more publicity than the first, owing to the relatively recent conversion to it of Jeans, Sir Oliver Lodge and others. In my opinion the two ideas should not be separated, but should stand or fall together.

As for the remainder of his letter, it is a pleasure to recognize his philosophical attitude. Every intellectual structure, cosmologies in particular, rests upon a system of postulates which are not matters of evidence. I have laid considerable stress upon this point in previous publications (see, for example, *Science*, August 7, 1925), and I should like to repeat that there is nothing compelling in any postulate. Only those who choose to adopt a postulate are bound by it; others are free to make another choice, or, if they are like the majority of people, they may refuse to consider the matter altogether.

The statement that "atoms are certainly being evolved somewhere" rests upon the postulate that *the universe does not change always in any one direction*. Assuming, as I have done, that atomic degeneration is the source of the stellar energies, then, in accordance with this postulate, regeneration is certainly going on somewhere. If one does not choose to accept the postulate the conclusion disappears of its own accord.

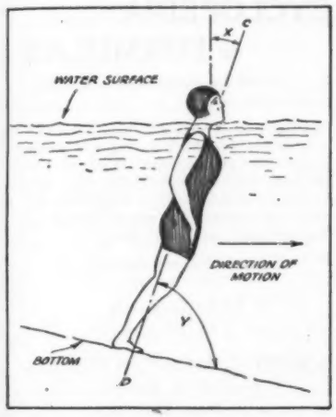
As to his references to creation, it seems to me that Professor McWilliams is connecting together statements that are rather far apart in my article. My allusion to our grandfathers and our fathers in my introduction was merely for the purpose of sketching hastily the flow of ideas in relatively recent times with respect to cosmology. Certainly many of the ancient philosophers and the early church fathers had very lofty

ideas on these matters, but they lay outside of the picture which I was sketching. On the philosophical side the question of creation is covered by the postulate that *the physical universe is continuous in time.* This postulate excludes the notion of creation, for the moment of creation would be a discontinuity. I believe that almost all scientists more or less consciously adopt this postulate. It is certainly one of the postulates of the doctrine of evolution.

As for the doctrine of design, I have no postulate which covers that point, and I cannot see any object to be achieved in making one. However, I am entirely in sympathy with any one who is interested in making a definite system of postulates. All that I ask is that he be careful that his postulates do not contradict one another.

There is nothing *a priori* that distinguishes any one system above all others.

Yours very truly,
W. D. MacMillan.



Compare the indicated angles in the above drawing with those in the illustration in the next column

More on the Subject of the Undertow

In the Scientific American Digest of last August there appeared an abstract of an article written by the noted physiographer, Prof. W. M. Davis, of Harvard, in which he undertook to demonstrate that the steady undertow of the ocean beach is a myth. Many of our readers now refuse to take the Professor's statements lying down. They say, in effect, "The undertow may be explained away—theoretically; but we have been in it, felt it, nearly lost our lives on account of it." Is this no-undertow theory to be exploded by a mere fact? Here is what one of Prof. Davis's opponents—name omitted by request—has to say about the undertow:

Editor, Scientific American:

To your discussions of undertow, will you permit me to add my own observations and deductions?

I am an expert swimmer and have swum much in the ocean at various Atlantic beaches and frequently during storms at Virginia Beach, Virginia, when the undertow was strongest.

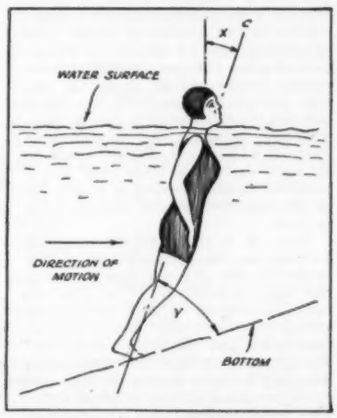
To non-swimmers the undertow frequently means a swift current *along* the beach, which tends to sweep them off their feet. This is obviously not the subject under discussion, but is mentioned here only to draw the distinction between that and the outwardly flowing current of the true undertow.

I am familiar with the theoretical circular or elliptical motion of the particles in a wave *before it breaks;* but after it breaks, a volume of water is thrown forward above the surface before it, and travels toward shore. Any swimmer can tell you the difference between the impact of the broken wave and the gentle lift of the unbroken swell; and the rush of the wave coming onto the beach will attest the movement of water shoreward, as each wave (after breaking) foams toward shore above a layer of comparatively quiet water. Incidentally, in shallow water, the incoming swirl of the wave draws with it, for a few inches, all the water, right to the bottom, as can be seen by the sand shifted from the ripples on the normal sand bottom. Probably this is due chiefly to friction.

The incoming waves, having traveled in, roughly speaking, on top of the water, the water runs up on the beach slope, recedes, following the slope until below the water-level, and *then travels outward below incoming breakers.* When swimming in rough water, I always take advantage of this when going seaward, by swimming with my feet well down, and diving deeply under incoming waves; but when swimming toward shore, it is far easier to swim flat on the surface and let the incoming waves help one ashore. I have never experienced a continuous outward current (though nearly so) as each incoming wave momentarily drags back the water below it.

The undertow seems to be greater as the slope of the beach increases, or as the surf becomes more heavy. In the first case, the return-flow from the beach starts with greater velocity, but is soon slowed down in the deeper water and is not troublesome; in the second, the return-flow is of greater volume, and can cause a considerable current.

There is another factor that affects the non-swimmer on a sloping bottom, that thus far seems to have been entirely overlooked. It has nothing to do with current, but to those unfamiliar with the water, it might be mistaken for an adverse current or undertow. It is the difficulty of walking up a slope with the body nearly submerged. The weight (that is, the pressure between the feet and the bottom) of any one submerged above the armpits is very slight, owing to the displacement of the submerged portion; consequently, it is harder to get a foothold because the friction of the feet on the bottom is less. At the same time, much greater force than usual is needed to move the body forward against the resistance of the water, and the body must be leaned far forward before any progress can be made. In other words, the thrust which the bather must exert against the bottom is inclined at an angle to the vertical, called "X." In climbing up a slope, the angle "Y" is small, compared to the angle "Y" in descending, and with the small friction existing, the feet get a very poor grip. In fact, it is very hard to climb a slope when nearly submerged, but very easy to descend. This may be tested by walking as far as possible down the sloping floor of any swimming pool, and then trying to walk back.



The difficulties of ascending a slope in the water may explain the sensation of an undertow

The Anti-Aircraft Question

Believing that the article on anti-aircraft artillery may have given rise to some questions in the minds of other readers, similar to those which occurred to Lieutenant Gardiner H. Fiske, we are passing along the additional information from Colonel Cloke received in connection with the following letter:

Editor Scientific American:

I have read Colonel Cloke's article in regard to the advances recently

made in fire control of anti-aircraft guns, which is of interest, but seems to be based on several false premises.

In the first place, the assumption is made that the target (enemy aircraft) is to travel "in a straight line, at constant speed and at uniform altitude" during "the period of time included in the time it takes to load the gun and the time of flight of the projectile." During the period September-October, 1918, our pilots and observers in bombardment squadrons were instructed to continuously change their altitude or direction when over the enemy's lines. This was usually done by a "skidding" to the right or left, "peaking down" slightly or by a slight side slip. Only directly over the objective would the plane remain at constant speed and altitude. This might be for five or ten seconds. It would appear that at an altitude of 12,000 feet, above which most day bombardment was carried on, under best conditions with the plane directly overhead, the pilot need only move the squadron once very eight seconds.

Colonel Cloke, in his figures for planes brought down, fails to make any difference for the planes brought down by machine-gun fire at low altitude and those brought down by 75's anti-aircraft fire at 12,000 feet. Naturally a plane "trench straffing," so-called, is very liable to be brought down; often being as low as 100 feet. In his figures of "results of the entire war," out of 58 planes brought down by U. S. anti-aircraft fire 41 were brought down by machine guns. Certainly the greater part of the planes brought down by anti-aircraft fire in all armies was brought down by machine guns during drives when "*at all costs*" orders had been issued and planes were sent over at very low altitudes to shoot up trenches or troop trains.

Under the heading "Rapidly Gaining on the Airplane" Colonel Cloke gives us the results of target practice at Fort Tilden in 1925—one "hit" for every 22 shots fired. How was this result obtained? Was the target altitude at 12,000 feet? Was the pilot changing his altitude or direction every eight seconds? Did the pilot try holding his plane "in the sun"—a maneuver universally used by all pilots—which keeps the plane as much as possible between the sun and the anti-aircraft batteries? The author does not say, but tries to leave the impression that the "tests" were made under the same conditions as held in the last war.

Colonel Cloke ends his article by saying that after the "first volley of shell bursts" his batteries would "squirt the hose" on an approaching group of bombing planes with "corrections based on observation being applied from time to time." I do not know what "from time to time" means, but I believe the "times" would have to be about eight seconds apart. His observers as yet cannot do this apparently.

However, I am glad to see that our "watchdogs of national defense" are going to make anti-aircraft guns more efficient. They will always have their function of keeping planes at a reasonable altitude, say, 10,000 feet. But I believe from experience that by far the best defense against bombardment planes is pursuit planes. I hope the government will not spend too much on the anti-aircraft guns.

Gardiner H. Fiske.
Former First Lieutenant, 20th A. S.
First Bombardment Group.

Colonel Cloke, author of the article under discussion, was asked to express his opinion on this letter and his reply follows:

Editor, Scientific American:

I have your letter with the enclosure. Permit me to reply as follows:

The basic assumption that aircraft travel in a straight line at constant speed and at uniform altitude is the theory only. This theory becomes more and more fragile as the type of plane varies from the heavy bomber. There are many types of anti-aircraft weapons, as follows:

Thirty-calibre machine gun
Fifty-calibre machine gun (Max. Vert. Range, 16,000 feet)
37 M.M. '25 (Max. Vert. Range, 14,000 feet)
3-inch '23 (Max. Vert. Range, 31,000 feet)
105 M.M. '26 (Max. Vert. Range, 42,000 feet)

We have a gun for each type of plane. For the swift-moving, sliding, zigzagging or tumbling pursuit plane, the machine guns are used as the weapon. The heavier types, such as bombers, when not directly over the enemy are assumed to take a straight-line course at a constant speed and altitude. This assumption may be wrong in some minor details, but it is the basic assumption made and, where a bombing squadron is discovered changing altitude and skidding to the right or left or side-slipping (this is readily and quickly discovered by fire-control instruments) a correction can be applied on the gun-sights for this.

There is no doubt but that the best weapon against enemy planes is the pursuit plane, but it is also a fact that anti-aircraft artillery bears the same relation to the aircraft of our own forces, and has practically the same functions to perform as do seacoast batteries bear to our own Navy in time of war.

The figures I have obtained for planes brought down, et cetera, can be found in *Army Ordnance*, published in Washington, D. C., September, October, 1925, by the Army Ordnance Association.

The "squirting the hose" proposition consists of the use of the 37 M.M. gun, which has a ceiling of 14,000 feet, effective range. This is an automatic gun, and although in its preliminary stage of development, it is effective. It pours a stream of fire as does any machine gun with tracer ammunition, on the enemy plane. By observation of fire in this case is meant following the stream of tracer projectiles by eye, and moving the gun on to the target.

It cannot be positively stated at the present time that our Ordnance Department will be able to produce a 3-inch automatic gun. They hope, however, to be able to do this and claim that it *can* be done. The production of a three-inch, high-velocity, automatic gun with tracer ammunition and supersensitive fuse will solve the anti-aircraft problem. Naturally the question is asked "How about ammunition supply?" The answer is, less ammunition would be needed in this case for the reason that it would take but a short time to destroy a plane.

I do not believe for a minute that anti-aircraft defense should be limited to land guns, but that the first defense against enemy aircraft should be our own aircraft, but, as with the Navy, our own aircraft should be free to move wherever necessary for concentration purposes and for our offensive attack in the same way in which our Navy is now permitted greater freedom of action, due to the protective value of seacoast fortifications.

There is a slight misunderstanding perhaps on the part of some of the readers of this article with reference to the basic assumption. This basic assumption is made for the period of time included between the "time when *the fuse is set* and the projectile bursts." We are reducing this time continually. The time between setting the fuse and firing the gun is called the "dead time." This has heretofore been considered as eight seconds, but there is now in the experimental laboratory of the Ordnance Department a device for automatic fuse setting. This will reduce the time between fuse setting and gun fire, "dead time," to about two seconds. The time of flight for the 105 M.M. gun will also be materially reduced, due to the high velocity which will be given the projectile. With this time element reduced, any slight side-slipping, skidding or peaking by a heavy bombing plane would not produce errors so great as to destroy the hitting power or the effective burst range of the 105 M.M. projectile. In other words, direct hits with this type of gun are not always expected.

I hope this will clarify the situation for your correspondent and I am pleased with the fact that this article has caused argument and controversy.

H. E. Cloke,
Colonel, C. A. C.

Science and Money

Common Stocks—The Pendulum Investment

By Henry C. Trundle

FROM the standpoint of position, common stocks are at the tail-end of a company's financial structure and at times there are not enough profits for the tail to wag and for dividends.

Naturally not all common stocks are to be classed as "cats and dogs" for any number of companies have dividend records on the common which would do many a bond or preferred stock proud. Sometimes also there are no bonds or other class of stock outstanding so that every cent over and above operating expenses is available for distribution to the common. In considering the purchase of common shares it is well therefore to ascertain just what securities are ahead of them and what balances have been accruing to the shares from year to year.

Common Stocks as a Bonus

At the formation of a company the common stock is frequently created to be given as a bonus to the organizers in consideration of their risks in time and money and also in order to stimulate all concerned to the greatest efficiency. Preferred stock is usually accepted to the amount of the cash actually invested, and the money so obtained is utilized in the purchase of plant and property, which later may serve as security for mortgage loans. A further use of common stock for bonus purposes is made when it may be necessary to "window dress" or "sweeten" an offering of bonds or preferred stocks. The prospective value of such free stock has often made possible the quick sale of securities which otherwise might have remained on the dealers' shelves. In other instances common stock of then little or no value is included as a part of a unit of sale, the intention of the management being to ultimately retire the bonds and stocks ranking ahead of the common, which when accomplished would leave all net earnings available for dividends on that stock.

Economists have recently been giving serious consideration to the question of voting and non-voting stocks. This question is important to common shareholders inasmuch as the control of the company may be held by a few men through the ownership of all of the voting shares, which actually may be only a few thousand shares in contrast to hundreds of thousands of the non-voting shares in the hands of the general public. The example is used of a very large automobile company, the control of which is held by a few men holding a small block of stock that may have cost them nothing, whereas the public has an investment of over a hundred million dollars in the bonds, preferred and class "A" common shares none of which securities have voting power. This control of large corporations by a few insiders is also accomplished through the organization of holding companies, in each case the voting stock being retained by a smaller group, so that the final effect is for a few shares owned by a few men to control companies with huge capitalizations. The limitation of voting powers to one class of stock has been done principally at the behest of banking interests who desire to keep the control of companies but who wish to have the public put up the actual money. Such shares are usually the so-called Class "B" common and they are frequently not purchasable in the open market.

Voting Usually Done by Proxy

In actual practice stockholders do most of their voting by proxy so that within every company there must be a small group of men who have the responsibility of its management. The defenders of the system of voting and non-voting stocks cite this as an example, stating that it is preferable to have the control definitely in their hands through the complete ownership of voting stocks rather than to have the control split up among so many persons and subject to outside influence. As a matter of fact it seems reasonable that the preferred stockholders and the bondholders should also have a voice in the management of the business in which they have invested. As such securities are endowed by law with certain rights which the common stock does not ordinarily have, the purchaser of the non-voting common shares must realize his junior position and that he is practically at the mercy of the voting shares.

Common Stocks Not Unsafe

The publication of several books within the past year and the subsequent newspaper and magazine discussions covering the advantages of common stocks for long time investment have changed the opinion of many persons who have considered such stocks as purely speculative and unsuitable for conservative minded investors. The result of these studies has been to establish that over a period of years common stocks afford a larger income and a greater appreciation in principal than do bonds or preferred stocks. While it may happen that dividends are discontinued for several years, causing a decline in market value, it was shown that the total dividends, extras, et cetera, paid on the common are in excess of the amount of interest or preferred dividends paid during the same period. The further contention was that the common shares, fluctuating with relation to the value of money and in accordance with economic conditions, provide opportunities for real profit. However, it was expected that purchases and sales would be made at the proper levels and the fact that income must be certain and the capital kept intact was counted out of the argument.

This much is true, that when the affairs of a company are in such a condition that the dividends have to be discontinued on the common, the position of the preferred stock and the bonds is lessened. A decline in market value of these securities naturally follows and default in interest or dividend payments is possible. It is only fair to say, however, that soundly managed companies build up reserves to tide them over temporary critical situations and that fixed charges can be met out of surplus for some time even though current earnings are insufficient.

Gage the Pendulum's Swing

One of the difficulties in owning common stocks is that information regarding the course of earnings and other data is very hard to obtain. For reasons of competition industrial concerns are not wont to give out earnings statistics except when compelled to or at the close of a year. Consequently the shareholder may go for many months on the theory that his company is prospering, whereas the opposite may be the true situation. This condition is somewhat better in the case of railroads for monthly statements are published by them giving the earnings, car loadings and other information upon which the decision to buy or sell shares may be based. Earnings of railroad companies fluctuate less than do those of industrial companies, but they are not as stable as the earnings of public utility companies. One good feature of the income of electric light and power, gas and water companies is that the trend has been consistently upward and if utility shares are not purchased at the height of a bull movement but are bought at a level in proper relation to the earnings the buyer should confidently expect to see a steady appreciation in market value over a period of years.

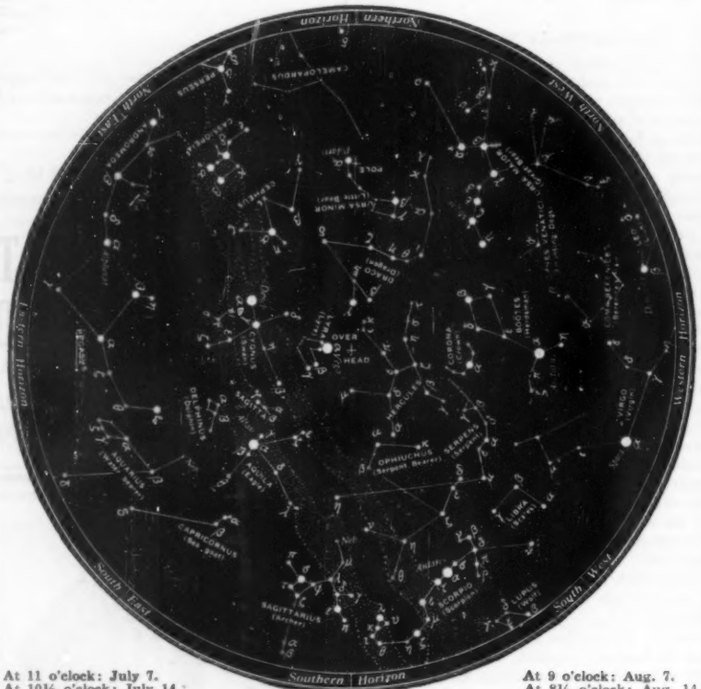
The policy of many utility companies of

paying dividends in stock, if preferred to cash, has increased the popularity of such shares, for as the market price of the stock advances the dividends so received have an increased value. The companies gain by this procedure as cash is conserved which can be used for extensions or equipment, thus doing away with public borrowing for such purposes. It possibly is to the investor's advantage to take his dividends in stock as a utility company can undoubtedly earn more on its money than the individual.

There is plenty of money to be made in common stocks, all agree, but when to buy and when to sell is the great problem. The price pendulum is long, the swings are irregular and the turns almost defy detection. Who dares to buy when depression fills the air and who wants to sell when prosperity seems never ending? Yet this is just what should be done. But it took real nerve to purchase the common shares of our railroads, industrials and utilities a few years ago which now are quoted many times their former values. And it took courage to decide to sell five or six months ago when every stock on the list was being boomed for further advances. Those who have timed their operations can show handsome profits, while others less fortunate probably have losses from which it will take a long time to make a complete recovery.

The Heavens in July

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: July 7.
At 10½ o'clock: July 14.
At 10 o'clock: July 22.
At 9½ o'clock: July 30.
At 9 o'clock: Aug. 7.
At 8½ o'clock: Aug. 14.
At 8 o'clock: Aug. 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on July 7, etc.

NIGHT SKY: JULY AND AUGUST

The Heavens

ON our star map this month we find the Milky Way passing almost overhead, with Cassiopeia, Cepheus, Cygnus, Lyra, Aquila and Sagittarius and Scorpio strung along its length from north to south. Andromeda, Pegasus, Aquarius and Capricornus are east of the Galaxy. Ophiuchus and Libra are in the southwest, Hercules, Corona, Boötes and Virgo in the west, Ursa Major in the northwest, and Draco and Ursa Minor in the north.

The Planets

Mercury is an evening star all this month and is well visible, being 26° from the sun at the time of greatest elongation, on the 11th. On this date he remains above the horizon until 8:50 P.M. and should be easily visible in the twilight.

Venus is a morning star far north in the heavens and very conspicuous, and rises at 2:30 A.M. in the middle of the month. Mars is in quadrature, west of the sun on the 9th and rises just before midnight (being 4° north of the equator). Although still more than eighty million miles away, he is already a conspicuous object, and as bright as Capella or Vega.

Jupiter is in Aquarius, and approaching opposition. He rises a little after 10:00 P.M. at the beginning of the month, and at about 8:00 P.M. at its close.

Saturn is in Libra well past opposition, and sets between 12:00 and 1:00 A.M. in the middle of the month. Uranus is in Pisces and visible in the morning hours. Neptune is in Leo and too near the sun to be observable.

The moon is in her last quarter at 8:00 A.M. on the 2nd, new at 6:00 P.M. on the 9th, in her first quarter at 10:00 P.M. on the 17th, full at midnight on the 24th, and in her first quarter again at 2:00 P.M. on the 31st. She is nearest the earth on the 26th, and farthest away on the 14th.

During the month she is in conjunction with Uranus on the 1st, Mars on the 2nd, Venus on the 6th, Mercury and Neptune on the 12th, Saturn on the 19th, Jupiter on the 26th, and Uranus again on the 28th, and Mars on the 31st.

On July 9th there occurs an annular eclipse of the sun. The path of central eclipse is entirely in the Pacific Ocean, starting north of New Guinea, ending 1,500 miles off the coast of Mexico, and passing over no charted land. A partial eclipse on the southern edge of the sun is visible in all parts of the United States south of a line drawn from Savannah to the southernmost part of Alaska.

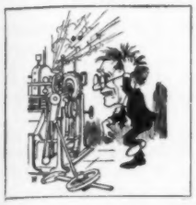
For observers east of the Mississippi the eclipse will be a small one just before sunset, but in California it will be of considerable magnitude and comes between 3:30 and 5:30 P.M., so that it will be worth looking at.

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Don'ts for Inventors



WHILE it is true that many of the great inventions of the past have been made by outsiders, most of the successful inventions today are made by men who have a thorough knowledge of the field in which they are working. If you are a printer, for example, the chances are that any invention in the printing art that you might make would be of real practical value, for you are inventing in a field with which you are familiar. In some other field where you have only a slight theoretical knowledge your ideas might appear to be all right but probably would be rejected by manufacturers as being visionary.

Don't choose a complex technical field for your inventive ability unless you have technical knowledge.

Mr. Brann Buys a White Elephant

THE fact that Patent Office models were to be sold some time ago was widely advertised. Who bought those models, however, and what has become of them has remained a mystery so far as the general public is concerned. Here is the story.

Harry Brann, a speculator living in New York City, read an alluring newspaper article about the wonderful models, many of them of industrial or scientific importance, which were to be sold because Congress was unwilling to continue to appropriate large sums annually for the purpose of storing them. Mr. Brann boarded a train, went to Washington and attended the sale. Two or three hundred other men were there, all bidding on the big miscellaneous collection of Patent Office models. He joined in, had the lot knocked down to him for $6,500, and paid a substantial deposit.

In due time thirty-six large packing cases, upon which he had to pay express charges of $200, were delivered to his rooms in New York. There was no space in his quarters for such a large assortment and he had to find storage elsewhere. Two of the cases he opened up and displayed the contents in his rooms.

"Now that I have this large and valuable collection, I do not know what to do with it," said Mr. Brann, calling at the Scientific American offices for advice in the matter. "There are inventions of every imaginable kind. Here is a list of some picked at random from the ones at my home:

The mailing machine invented by A. Knowlton in 1880.

The coffee pot invented by J. Zimmerman in 1867.

The flywheel for engines invented by Pierre E. Jay in 1878.

The grinding mill invented by W. N. Cosgrove in 1881.

The magnetic telegraph invented by Charles Kirchhof in 1865.

The canceling machine for bonds invented by Joseph N. Hurley in 1887.

The boot-tree invented by W. Upfield in 1857.

The cream freezer invented by E. E. Seaman in 1848.

The clothes wringer invented by J. H. Kooser in 1872.

The wash tub invented by J. Wright in 1851.

"There is no doubt that a lot of valuable models are contained in this collection, but what they are, frankly, I do not know. Some of them would be of interest to industrial organizations founded on particular inventions. Others would have a personal interest for descendants of inventors.

"I have offered the collection to a number of leading men and organizations, including Henry Ford, Thomas Edison, W. C. Durant, and the American Telephone and Telegraph Company. I hope somebody will take it off my hands for it is really a white elephant. White elephants are very valuable, but what can you do with them?"

This is a Japanese certificate of registration for American made cotton goods. Registrants are advised to place the words "Tō roku shō hiō" on registered goods as this means "Registered Trademark" and warns would-be infringers

A Recipe for Wealth

THE story of the man who tried many things, failed at them all, and then made a fortune by writing a book on "How to Succeed" is an old one. The reverse of that story comes to light in a fraud order by the Postmaster General barring the use of the mails to V. M. Thompson and Company, of Cincinnati, Ohio.

The business consisted principally, the Postmaster found, of selling by mail books and pamphlets which purported to aid the purchaser to achieve financial success. "Stepping Stones to Wealth," "Building Your Business by Mail" and "Real Experience" were the titles of three of them. Thompson advertised that he himself had been led "straight to success" by means of the information in one of the books he was selling. He also advertised that his concern was a big supply house and filled all orders for books the same day they were received.

As a matter of fact, Thompson and his wife lived in two small rooms over a barber shop in one of the poorer sections of Cincinnati. One of the rooms they used as a kitchen and the other as a bedroom and office. The total receipts from the business for a year were $1,000 and of this $750 was spent for postage and printed matter. Hundreds of complaints were received by the Post Office because of months of delay in receiving books ordered. Thompson's publishers refused to make deliveries to him until he paid his printing bill.

Nevertheless, Thompson was continuing his advertising in undiminished volume until stopped by the Postmaster General. If the printer and the public had only had patience enough, who knows but what he might have made his success story come true?

Scrapped on Delivery

"DO you expect me to pay this bill of $2,500 bills for labels, when you know they're useless?" demanded a manufacturer recently.

"Certainly," replied the lithographer to whom he was protesting.

"But didn't you suggest the design for them?"

"Yes."

"And don't we now know that design is the property of another manufacturer and isn't he ready and able to prevent my using it?"

"That's true, but they are your labels. I printed them for you on your order."

So they went at it. The manufacturer was out $2,500; the lithographer lost the future business of a good customer. All because nobody had thought before having the labels made to find out whether or not the design already was registered. Either party readily could have found out through his lawyer that the right to use a label like that belonged to another firm.

Within a period of three weeks four such cases were brought to this editor's attention. By the same lack of forethought a drug manufacturer was out $2,600, a perfume manufacturer $800, a hosiery mill $1,500, and a maker of food products $2,500. It is a costly form of carelessness that seems to be growing.

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Apparel

SLEEPING GARMENT.—Which combines within itself the adaptability for use as a bath robe, in addition to its main use. Patent 1574651. C. Hildreth, 1842 Pepper Ave., Lincoln, Neb.

WATERPROOF FOOTWEAR.—Which has the appearance of the ordinary shoe, but will wear longer, the leather not drying out as fast as ordinary leather. Patent 1577791. L. Dreschler, 1314 Stodtman, St. Louis, Mo.

Chemical Processes

PROCESS FOR PRODUCING BORAX AND SODIUM BICARBONATE FROM LAKE BRINES.—By evaporation, whereby the crystal borax and sodium bicarbonate are precipitated and heated to substantially boiling temperature. Patent 1573259. M. V. Lowry, c/o Western Chemical Co., Syndicate Bldg., Oakland, Calif.

REFINING PROCESS FOR PEARL ESSENCE.—Wherein the raw material containing the brilliant crystalloids is treated by means of a biological reagent, and the crystalloids separated from the residues. Patent 1576,454. J. Paisseau, 5 Rue Blondel Courbevoie, France.

Of General Interest

SCALP-TONIC APPLICATOR.—Whereby the tonic may be applied and rubbed into the scalp substantially at the same time. Patent 1574418. P. Coviello, 430 W. 42nd St., New York, N. Y.

GRAVE MARKER.—Which affords facilities for supporting a card containing data, the card being protected against the action of sunlight and weather. Patent 1574621. P. J. Good, Camden, Maine.

SIGN.—Having removable letters, and a holder for supporting and displaying the letters in desirable relation to one another. Patent 1574652. A. Holder, 212 E. 25th St., Los Angeles, Calif.

CESSPOOL.—So constructed that the pipe or conduit will never become clogged with grease or solids which gravitate to the bottom. Patent 1574603. W. T. Burtis, Glen Head, L. I., N. Y.

CONVERTIBLE FLOWERPOT AND HANGING BASKET.—Which will supply plants with water in a proper and effective manner without danger of the water spilling. Patent 1572548. R. E. Mattison, Box 354, Montello, Wis.

CALCULATOR.—Especially adapted for the use of linemen, wiremen, and engineers for determining wire sizes for light or power. Patent 1572547. R. W. Malder, c/o Kenlin, Roedell & Hoffman, Bank & Insurance Bldg., Dubuque, Iowa.

TROLLING GEAR.—Having a spinner adapted to function at or directly near the point of the hook, for fresh or salt water trolling. Patent 1573288. —A. W. Wilson, 180 Duboce Ave., San Francisco, Calif.

CONCRETE REENFORCEMENT.—Which may be assembled and interlocked in skeleton structure, and rigidly secured together by the solidification of the concrete. Patent 1573735. G. M. Nelson, Box Q, Monterey, Calif.

CASEMENT WINDOW.—In which the frame and sash are so constructed as to effectively prevent the ingress of moisture and air, when closed. Patent 1576461. J. Polachek, J. Jepsen and E. Peremi, c/o Polachek Bronze & Iron Co., 476 Hancock St., Long Island City, N. Y.

TELEPHONE-DIRECTORY STAND. — Having means for conveniently holding an indicia bearing sheet of telephone numbers against accidental obliteration. Patent 1573560. M. H. Mann, 55 Second St., San Francisco, Calif.

PRICE-TAG HOLDER.—For displaying price tags in front of goods disposed on shelves in stores handling a miscellaneous assembly of goods. Patent 1572994. D. Garfinkle, 2407 San Jose Ave., Alameda, Calif.

SELF-LOCKING COVER.—Particularly adapted for use in connection with milk can covers of usual form without requiring change in the construction. Patent 1573279. I. V. Silveira, P. O. Box 330, San Jose, Calif.

MAIL BOX.—Which affords facilities for preventing unauthorized removal of mail or articles, yet permits easy access by authorized persons. Patent 1574354. H. C. Barth, Helena Apartments, Helena, Mont.

CARRIER OR HOLDER FOR ARTIFICIAL BAIT. —In which a series of artificial minnows may be supported and protected, yet permit of ready release and selection. Patent 1574,-416. F. H. Campbell, Lewisburg, W. Va.

SAFETY APPARATUS FOR USE IN MINES.—Designed to cut off the supply of air to regions affected to explosion or fire, thereby saving life and property. Patent 1575626. H. W. Haapanen, Box 86, Sturgis, Ky.

DOOR CONSTRUCTION.—For show cases, cabinets, and like structures, whereby the door is continuously urged toward closed position. Patent 1576098. J. G. Deitz, 1507½ So. Main St., Tulsa, Okla.

JETTY.—Which will effectually prevent the erosion of river banks and maintain the river along a predetermined course. Patent 1574,-153. H. F. Kellner, Silver Lake, Kansas.

STIFFENING AND PROTECTING DEVICE FOR RUGS.—In the form of a flat element having attaching means for maintaining the corners flatwise and preventing curling. Patent 1573828. J. L. Hamilton, Red Bluff, Calif.

FIXTURE HOLDER.—Adapted to properly mount and hold the so called recessed type of fixtures in bath room walls which are not tiled. Patent 1576457. J. H. Petty, 1012 Quinton Ave., Trenton, N. J.

GATE.—Automatically operable by an automobile or truck, to permit the same to pass through, the gate automatically closing after the passage. Patent 1576442. J. W. Matthews, Menard, Texas.

EARRING SAFETY GUARD.—For supporting an earring and relieving the pain frequently caused by the hanging weight stopping blood circulation. Patent 1576372. E. J. Shea, 32 Court St., Brooklyn, N. Y.

DUAL SOUNDING RATTLE.—Which produces both a rattling sound and a sound imitating a baby's voice, by manipulations of the handle. Patent 1576231. I. E. Cohn, 64 4th Ave., New York, N. Y.

SIZE INDICATOR FOR GARMENT HANGERS. —Designed to bear indicia relative to the garment, the marking device being readily interchangeable. Patent 1575775. B. Lesser, 33 W. 34th St., Room 804, New York, N. Y.

DISPENSING DEVICE.—In which novel means is employed for releasing merchandise, such as candy and the like from a normally closed container. Patent 1575972. B. B. Cochran, c/o Goblin Mint Co., 1241 Belmont Ave., Chicago, Ill.

IRONING BOARD ATTACHMENT.—Adapted to be extended longitudinally of the edges of the board for supporting large pieces of goods. Patent 1576929. C. A. Parkinson, 819 Wisc St., Berlin, Wis.

WRIST PENCIL AND HOLDER THEREFOR.—Capable of being held in a support with a wrist watch, a spring, and flexible connection securing the pencil. Patent 1577272. L. E. Treadaway, 12 Davis Bldg., Daytona, Beach, Fla.

DISPENSING DEVICE.—In the form of a fountain tooth brush, in a cylindrical hold, not materially in excess of a fountain pen. Patent 1576750. W. W. Kinsley, Jamestown, Kansas.

SURFACE PROTECTOR.—For the bases of lamps, telephones, and similar articles, supporting the base, and preventing marring or scratching surfaces. Patent 1577281. S. Matzner, 1350 Broadway, New York, N. Y.

ARTICLE CARRIER.—Which may be applied to the handle bars of a baby carriage, for the transportation of packages and parcels. Patent 1577298. Mary A. Roeller, 3407 41st St., Long Island City, N. Y.

CLOTHES HANGER.—Adapted to support one or several articles and to be capable of removal or for storage of ladies' dresses. Patent 1577290. L. I. Nash, 1027 Rose St., Far Rockaway, N. Y.

ADVERTISING DEVICE. — Which displays matter to be advertised in a unique form, and employs a minimum number of simple parts. Patent 1577213. R. S. Fenner, 146 1st St., Newark, N. J.

QUILT COVER.—With means for fastening the same in such manner that the quilt and cover are held in proper relation. Patent 1577226. R. Greenberg, 860 Huntspoint Ave., Bronx, N. Y.

SCAFFOLD BRACKET.—Readily attached to the wall of a building, is adjustable, strong, and may be folded when not in use. Patent 1577234. J. Hubeny, 533 Spring St., Elizabeth, N. J.

ARTIFICIAL CHRISTMAS TREE.—Composed of readily assembled and separable parts, which may be stored in a small space. Patent 1577207. W. Dieperink-Langereis, 517 E. 2nd St., Jamestown, N. Y.

FIRE ESCAPE.—Comprising a steel cable with combined guiding and braking means manually controlled, and an automatically controlled weight regulator. Patent 1578,-108. N. Tobias, c/o S. M. A. de Sousa, 32 Church St., Kingston, Jamaica.

SCREEN.—Which functions not only as a screen, but as a ventilator which enables the window to be left open in stormy weather. Patent 1578095. C. R. Ryan, Box 63, Cuba, N. Y.

RUBBER TOOTHBRUSH.—Adapted to effectively clean all the surfaces of the teeth and massage the gums without injuring the same. Patent 1578074. J. Chandler, 302 Providence Exchange, Toledo, Ohio.

BOOK-MATCH COVER.—Capable of being folded to convert the same into a receptacle for ashes, burnt matches, or smoking refuse. Patent 1578119. A. B. Harris, 522 5th Ave., New York, N. Y.

JELLIFYING PRODUCT AND METHOD OF MAKING SAME.—Whereby when the product is removed from the container, they will of themselves divide into separate portions. Patent 1578122. M. W. Higgins, 14 Carstensen Road, Scarsdale, N. Y.

CURTAIN DRAPER.—Conveniently attached to a window frame, will be out of the way when not in use, and readily moved to operative position. Patent 1577486. R. A. Norton, Drawer D. P. 23, Fort Lauderdale, Fla.

SUPPORT AND SHIELD FOR FLATIRONS.—Providing means whereby the iron may be supported so that the work surface may be employed for steaming fabric. Patent 1577,-790. T. A. C. Cook, 3330 Sheridan Road, Chicago, Ill.

SANITARY COVER FOR TELEPHONE MOUTHPIECES.—An inexpensive device for preventing the collection of germs or dust, thus making the mouthpiece more sanitary. Patent 1578165. G. B. Mullen, Bell Ave., Bayside, N. Y.

DOLL'S EYES.—With means for properly positioning the eyes at the openings in the head, without the eye-balls rubbing or binding. Patent 1578176. I. A. Rommer, c/o Ideal Toy & Novelty Co., 273 Van Sinderen Ave., Brooklyn, N. Y.

SANCTUARY LAMP.—Wherein means are provided for utilizing a candle, and automatically causing the light to remain in the same position. Patent 1578087. R. C. Norton, 350 Mercer St., Jersey City, N. J.

TOY SCALE. — Constructed sufficiently strong to stand rough usage by children, without breakage. Patent 1578137. J. Kaplal, 380 Thames St., Newport, R. I.

COOKING APPARATUS. — Particularly designed for baking tortillas so that both sides of the disk may be properly baked. Patent 1579147. L. Romero, c/o Dr. J. Navarro, 8a, 218 Juarez, Mexico.

TRUNK.—Giving easy access to the interior of the end portions without detaching various trays from the body. Patent 1577,-745. J. C. Grider, 2523 Hillegas Ave., Berkeley, Calif.

CALENDAR.—By which may be readily determined the day of the week on which any predetermined day of the year falls. Patent 1577967. G. F. Hawley, 141 California St., San Francisco, Calif.

ATTACHMENT FOR FOUNTAIN PENS AND THE LIKE.—Which consists of a rubber collar for holding a combined fountain pen and automatic pencil in the coat of the user. Patent 1578596. L. Fritz, 648 S. State St., Chicago, Ill.

VENTILATED SEAT.—For use in railroad coaches or vehicles, to aid in keeping the occupant cool by air in summer weather. Patent 1568471. M. Roemer, Lost Hills, Calif.

COMBINED MATCH BOX AND BELT BUCKLE. —Which affords facilities for detachably connecting the ends of a belt, and will occupy but little more space than ordinary belts. Patent 1578468. J. Rankin, Louisa, Ky.

FRAME CONSTRUCTION. — For openings such as windows, eliminating casings and wood trim and providing a guide to which a plastic covering may be finished. Patent 1578796. I. A. Baum, c/o Stickley & Fitzhugh, 1010 Federal Bank Bldg., Memphis, Tenn.

COLLAPSIBLE IRONING BOARD.—Especially strong and yet when folded can be stored in a trunk or suit case. Patent 1579123. M. F. McCabe, 78 Prospect Park West, Brooklyn, N. Y.

KEY HOLDER.—Particularly designed to receive the keys of a motor car, whereby the keys may be readily swung to position for use. Patent 1579153. A. A. O. Seeler, 15 Maiden Lane, New York, N. Y.

RING.—Having the usual appearance, while certain parts may be readily removed and replaced by a different ornamentation. Patent 1579148. R. Rosenthal, 15 John St., New York, N. Y.

FOLDING COMB.—Which facilitates the carrying of an average sized comb in a small amount of space. Patent 1579143. M. Rabb, c/o Hercules Novelty Mfg. Co., 126 South St., Newark, N. J.

BED.—So constructed that when not in use it may be folded and stored in a small space. Patent 1579115. E. P. Kebbe, 342 Broadway, Everett, Mass.

MOISTENER. — For moistening and for flavoring tobacco products, the device is freely movable and obviates the use of absorbent material. Patent 1579111. J. R. Hinkson, 580 Parkside Ave., Brooklyn, N. Y.

SHAVING OUTFIT.—Wherein the soap and the container are formed to co-act and present a structure acting as an ordinary shaving mug. Patent 1579103. G. W. Gerow, Vail Gate, N. Y.

CONTAINER FOR FOLDED TISSUE TOILET PAPER.—By means of which the withdrawal of the tissue paper from the container is facilitated. Patent 1577094. L. J. Arms, c/o R. C. Pell, Jr., San Francisco, Calif.

Hardware and Tools

PRUNING IMPLEMENT.—For the use of gardeners and beet thinners, the device having changeable blades of varying width. Patent 1572426. J. H. Foot, R. F. D. No. 1, Delta, Utah.

HACK-SAW FRAME.—Which is extensible and adjustable, and equally well adapted to be used upon work of large or small dimensions. Patent 1572823. F. A. Stierheim, Riceville, Pa.

SURFACE CLEANER.—Having a pair of flexible blades which frictionally engage the surface to be cleaned. Patent 1574606. W. B. Lynch, 4719 6th Ave., Brooklyn, N. Y.

ATTACHMENT FOR MITER BOXES.—In which the saw is not only guided in the cutting movement but supported at the same time. Patent 1574663. E. Leske, Jr., 3281 Hull Ave., Bronx, N. Y.

INSERTABLE SAW TOOTH AND HOLDER THEREFORE.—For holding the tooth securely in such manner that strain and pressure will not affect the tension of the saw. Patent 1574609. A. M. Currier, 315 E. 3rd St. Aberdeen, Wash.

VALVE.—Wherein the coacting faces of the seat and valve plug will set up a grinding action to prevent leakage. Patent 1575449. S. L. Mozian, Ward's Island, New York, N. Y.

DRILL.—For deep wells, with means for building up a concrete lining or casing for the well during the actual drilling operation. Patent 1574040. A. W. Lasher, 302 Oak-Ave., Oakland, Calif.

TURRET-TOOL HOLDER. — Constructed to hold a plurality of standard bits, and to permit accurate presentation of the tools to the work in proper order. Patent 1574741. H. B. Day, c/o E. J. Crenshaw, Furniture Bldg., Evansville, Ind.

PAPER HANGER'S KNIFE ATTACHMENT.—Which is adapted to guard and guide the blade when trimming wall paper to fit the corners or baseboards of rooms. Patent 1574641. G. A. Christopherson, 1547 California St., San Francisco, Calif.

NONFREEZING SILL FAUCET.—Especially designed for use on sills of dwellings or buildings where the discharge end is exposed to the weather. Patent 1575547. F. Conrad and S. Rasmussen, 109 Elm Ave., Bogota, N. J.

NUT LOCK.—Which affords facilities for releasably and securely holding a nut against retrograde movement on a bolt. Patent 1574619. F. A. Gibson, Jupiter, Fla.

FURNITURE SPRING.—The upper and larger end convolutions of which are connected and braced by suitable coil spring connecting elements. Patent 1576441. V. Massacese, c/o A. Verner, 476 9th Ave., New York, N. Y.

PEELER.—For fruit and vegetables, constructed with a coring edge, and a thumb guard for preventing thumb abrasions. Patent 1574284. J. H. Gills, Commercial Hotel, Gainesville, Texas.

INSIDE PIPE CUTTER.—Adapted to be moved within a tubular member to the desired position and then operated to cut through the walls. Patent 1577474. G. F. Le Bus, c/o Le Bus Rotary Tool Co., Electra, Texas.

FENCE CONSTRUCTION.—In which each unit consists of a pair of sections detachably connected, whereby a passageway between supports may be readily made. Patent 1578,-217. J. Sutter, 3 Hull Ave., Maspeth, N. Y.

LOCKING DEVICE.—Capable of being used in conjunction with two closures, being carried by one and preventing the movement of both. Patent 1579107. F. L. Hanle, 43 Morgan Place, Kearney, N. J.

CLAMP FOR WINDOW LOCKS.—For holding the two sashes of a window in spaced relation for ventilation, without permitting increase of the opening. Patent 1568374. A. T. Gibson, 427A Hawthorne Ave., Oakland, Cal.

CAN-PERFORATING DEVICE.—Usable with cans of various heights and diameters such as containers for milk and the like for forming an outlet and vent opening. Patent 1577957. D. P. Dalmas, 426 Tennessee St., Vallejo, Calif.

LOCKING PLATE FOR CYLINDER LOCKS.—Which will not only prevent the rotation of the lock, but will present an ornamental effect. Patent 1579139. J. E. Phillips, 260 Convent Ave., New York, N. Y.

VALVE FOR WATER, STEAM, AIR, GASES, OILS AND OTHER FLUIDS.—Independent of discs of leather, rubber or composite material for its cutting-off property. Patent 1578349. H. C. Nixon, 749 Ave. N, So. Saskatchewan, Canada.

Heating and Lighting

OVEN CLOSURE.—For bakers' ovens, including cooperative doors for the introduction of goods of various sizes and to prevent unnecessary escape of heat. Patent 1576451. J. Nolla, 42 Paterson Ave., New Brunswick, N. J.

DRY-HEAT CURING CABINET.—For use in vulcanizing rubber, more especially in the treating of shoes or tires. Patent 1577291. E. Nestler, c/o Nestler Rubber Fusing Co., 245 W. 55th St., New York, N. Y.

BURNER.—Especially designed for the burning of fluid fuel, whereby the assemblage provides for efficiency in the application of heat and the regulation of the fuel and air. The inventor has been granted two patents, 1578133 and 1578135. A. Kais and A. Zaugg, 5659 Linwood Ave., Highland Park, Detroit, Mich.

SAFETY VALVE FOR HOT-WATER HEATERS. —Particularly adapted for use in cold climates, with the ordinary type of range having a water chamber for heating a system of pipes. Patent 1578046. H. H. Logan, c/o Duro-Metal Products Co., 2649 N. Kildare Ave., Chicago, Ill.

HOT-WATER TANK.—In which the upper part may be heated in a relatively short time and will remain hot a relatively long time. Patent 1581907. E. T. Barron, 423 W. Lake St., Minneapolis, Minn.

Machines and Mechanical Devices

LOOM BUNTER.—Which will function to positively stop the loom on a quarter of a pick or a quarter of a turn of the lay. Patent 1576285. A. H. Landry, Box 15, Townsend, Mass.

WEIGHT SCALES. — Which eliminates springs from its construction so that the scale will not lose its accuracy with use. Patent 1573869. W. M. Sanders, Eagle Creek, Ore.

SNOWPLOW.—Having a power unit for picking up the snow, and a means for discharging the snow a distance to the road side. Patent 1574230. F. W. Brown, c/o V. E. Gabrielson, Court House, Fort Dodge, Iowa.

STILL.—Of the type known as coke stills especially adapted for use in refining oil, the device permits of expansion and contraction without buckling. Patent 1575919. G. H. Hurshman, 770 C. Y. Ave., Graybull, Wyo.

TEASEL-CLEANING MACHINE.—Which will automatically clean a series of teasels, used in the manufacturing of nap goods, in a minimum time. Patent 1577296. M. Poetzsch, 91 Overbrook Road, Ridgewood, N. J.

CYLINDER PROTECTOR.—Providing means for preventing the accumulation of fallen rust, scale, sticks, etc., in the working barrels of wells. Patent 1576926. A B. Mueller, Runge, Texas.

LOADER CONVEYER.—Which can be easily adjusted to conduct material to a given point from a point within a considerable area. Patent 1576910. W. W. Hudson, c/o Porcupine Paymaster Mine, So. Porcupine, Ontario, Canada.

DEVICE FOR SURFACING MOLDING OR THE LIKE.—By means of which molding can be polished before leaving the mill, thus obviating subsequent sand-papering. Patent 1576645. S. E. Eskew and L. Harris, c/o Moses Pulverman, Benton, Ill.

BOTTLE-WASHING DEVICE.—Which may be connected with an ordinary household faucet for simultaneously cleansing the interior and exterior of a bottle. Patent 1577236. G. Huss, 357 E. 87th St., New York, N. Y.

BOILER-TUBE-SCALING DEVICE.—By means of which a piston with hammerlike stems encounter the walls of the tube as the piston is reciprocated. Patent 1577300. S. Sorensen, 1629 Castleton Ave., Port Richmond, S. I., N. Y.

DASHPOT.—For use with governors for engines, the device will take care of emergencies while ordinarily acting in the usual capacity. Patent 1578148. O. G. Lissen, 151 Highland Ave., Jersey City, N. J.

WELDING MACHINE.—Which allows of the forcing together of the two heated elements with sufficient speed to prevent cooling of the faces. Patent 1577818. C. L. Stancliff, 1005 Oregon St., East Bakersfield, Calif.

BELT.—Of heat resisting material, to be used as a conveyer or elevating belt. Patent 1578727. Z. F. Harshton, c/o Imperial Belting Co., Lincoln and Kinzie Sts., Chicago, Ill.

ELEVATOR SAFETY DEVICE.—Automatically operated whenever a door is opened either on the elevator car, or in the shaftway, to lock the controlling mechanism of the car. Patent 1578604. H. G. Hillman, c/o J. T. Clark, 9 E. 39th St., New York, N. Y.

TACK DRIVER.—Particularly adapted for securing the covers on cheese boxes, or other subjects ordinarily quite difficult to handle. Patent 1579120. E. J. Kramer, 407 Harwood St., Green Bay, Wis.

CONDENSATION DRAIN DEVICE.—Adapted to be operatively connected to the air system of an air brake apparatus, or any other power mechanism. Patent 1579073. H. L. Bullock, 84 Cloverdale Ave., North White Plains, N. Y.

Medical and Surgical Devices

TRUSS.—Capable of a wide range of adjustment whereby the same may be readily regulated to register with the afflicted part. Patent 1581009. T. McSherry, 19 Liberty St., Long Branch, N. J.

SYRINGE ASPIRATOR.—Which makes possible the aspiration of fluids from, and the injection of medicated fluids into the veins, arteries, or other cavities of the human body. Patent 1572075. W. G. Painter, Big Stone Gap, Va.

SYRINGE.—Having a nozzle assemblage which will minimize or prevent discomfort and pain by reason of its mode of application. Patent 1574694. W. Richards, 13 Hertzel St., Warren, Pa.

DOUCHE TABLE.—The construction being simple and of such design that the water will drain off readily. Patent 1572096. H. F. Wagley, Mineral Wells, Texas.

Musical Devices

TAMBOURINE.—Having an assemblage of jingle and castanet elements so associated with a sound board as to be effective in playing. Patent 1576443. E. C. McElhany, 436 Portage St., Kalamazoo, Mich.

XYLOPHONE. — The inventor has been granted two patents, wherein the sounding members are suspended by a comparatively straight single member near each end, and metal sides support the strings which carry the vibratile members. Patents 1575960 and 1575963. W. Bartholomae, c/o Bar Zim Toy Mfg. Co., 113 4th Ave., New York, N. Y.

PEG FOR STRINGED INSTRUMENTS.—In which the tension may be increased or decreased at will without the use of tools of any sort. Patent 1579987. M. O. Wickes, Northampton, Mass.

Prime Movers and Their Accessories

VALVE.—A rotary valve, so constructed as to operate as a fan to scavenge the valve casing and combustion chamber. Patent 1572085. C. W. Risden, 1452 W. 49th St., Los Angeles, Calif.

LUBRICATING SYSTEM FOR INTERNAL COMBUSTION ENGINES.—Wherein the lubricant is supplied in proportion to the speed at which the engine is running, and is shut off when the engine stops. Patent 1574410. C. L. Powell, Mawry City, Tenn.

ROTARY VALVE.—Which will afford facilities for controlling admission of fluid fuel to one or more cylinders of an internal combustion engine. Patent 1576591. C. C. Foss and D. D. DeLoach, c/o C. D. Russell, 518 Realty Bldg., Savannah, Ga.

ENGINE.—By means of which the stroke of the slide valves associated with a plurality of cylinders may be simultaneously regulated to admit steam. Patent 1576830. W. V. Jordan and T. M. Swank, c/o T. M. Swank, Leconoto Citrus Co., Leconto, Fla.

DYNAMIC COMPENSATOR.—For use in connection with such prime movers as engines of motor vehicles, alternating current induction motors, steam turbines, etc. Patent 1578223. M. J. Waclaw, 649 E. North St., Bethlehem, Pa.

Railways and Their Accessories

WATER COLUMN FOR LOCOMOTIVES.—Which is of such a character that it will be universally applicable to different sizes and types of locomotives. Patent 1575381. A. H. Oelkers, 796 E. Walnut St., Springfield, Mo.

RAIL STRAIGHTENER.—Which affords facilities for making use of a relatively slight force to bend a rail of relatively great resistance. Patent 1578381. L. W. Baker, General Delivery, Blue Rapids, Kans.

ROOF CONSTRUCTION.—In which the running-board and the roof-sheets are combined to form a complete roof of a car, eliminating separate running-boards. Patent 1581978. A. H. Oelkers, Chief Mech. Engineer, St. Louis & San Francisco R.R. Co., Springfield, Mo.

Pertaining to Recreation

GOLF APPARATUS. — Whereby various strokes of golf may be practiced indoors, and the values of a given shot on a regular course closely approximated. Patent 1574,596. E. L. Barnett, 149 Lexirgton Ave., New York, N. Y.

GOLF CLUB.—Having means whereby the head and the shaft can be firmly and efficiently connected without the necessity of whipping them together. Patent 1575460. C. Sunter, c/o Thos. Keogh, 233 Broadway, New York, N. Y.

WALKING TOY.—Adapted to walk in simulation of the animal, or other object which the toy is constructed to represent. Patent 1576435. A. Gund, Ridgefield, Conn.

AMUSEMENT DEVICE.—Which may be located in public places, affording amusement, and requiring skill in the manipulation of a coin to secure a prize. Patent 1578116. C. Fleischer, 52 Van Sinderen Ave., Brooklyn, N. Y.

BASKETBALL GAME APPARATUS.—Whereby a game resembling all the plays which actually take place in a game of basketball, may be played. Patent 1579172. J. W. Weaver, 415 Cutler St., Raleigh, N. C.

EXERCISING APPARATUS.—By which various movements of the arms, legs and body can be effected to simulate rowing and other forms of exercise. Patent 1577809. E. T. Randall, 117 W. Ave. 31, Los Angeles, Cal.

Pertaining to Vehicles

SANDING DEVICE.—By means of which the quantity of sand distributed in front of the wheels can be regulated from the driver's seat. Patent 1575098. R. H. Conty, 1122 Hyde Park Blvd., Chicago, Ill.

PROTECTOR FOR AUTOMOBILES.—In the form of a cover adapted to overlie the hinge of the hood to prevent the entrance of rain. Patent 1575510. M. J. Schwanck, c/o Smith & Wild, 209 McCandless Bldg., Honolulu, Territory of Hawaii.

AXLE.—For use on wagons, constructed to obviate the need of reducing the cross section at the point of wheel attachment. Patent 1575064. F. M. Kennedy, Clarendon, Ark.

SPRING-PERCH REMOVER.—For removing spring perches from the front axles of Ford cars, without removing the axle from the car. Patent 1575517. A. I. Albright and F. L. Myatt, Box 327, Monroe, La.

GLARESHIELD.—Adapted to be mounted in front of the windshield, to protect the eyes against sun rays and headlight glare. Patent 1574899. A. T. Kellogg, c/o The Texas Co., Room 816, Houston, Texas.

REMOVABLE FRAME FOR MOTOR OR LIKE VEHICLES.—Having means for automatically fastening or rendering motionless movable glazed or other frames for vehicles. Patent 1 76261. G. Baehr, 2 Rue des Sablons, Paris, France.

AUXILIARY RIM AND TIRE.—Which may be quickly disposed upon a vehicle wheel for taking the place of a deflated standard pneumatic tire. Patent 1575956. L. E. Williams, Benton, Ill.

AUTO ATTACHMENT.—For preventing rearward movement of a car when in operation, particularly when stalled or ascending a hill. Patent 1576265. S. Beringer, 293 Pondfield Rd., Bronxville, N. Y.

SIGNAL LAMP.—Especially designed for use by traffic officers or drivers of vehicles, adapted to be associated with the wrist and hand. Patent 1576235. M. M. Cunningham, Smith St., Far Rockaway, N. Y.

AUTOMOBILE SPOTLIGHT.—Which can be rotated horizontally or vertically by the turning of a shaft extending through the car body. Patent 1574050. H. E. Montgomery, 8246 Northfield Ave., Detroit, Mich.

RIM AND TIRE CONSTRUCTION FOR VEHICLE WHEELS.—Whereby a tire having a given air capacity will be capable of sustaining a relatively great load without rupture. Patent 1574277. M. T. Conroy, c/o H. M. Grove, R. F. D. No. 1, Cuyahoga Falls, Ohio.

ENGINE EXHAUST.—Which embodies a cut-out readily opened to permit the gases to pass direct to the atmosphere, in addition to the ordinary muffler. Patent 1576,040. W. C. Dial, c/o H. D. Vories, Hatcher Bldg., Pueblo, Colo.

AUXILIARY ROAD SPRING.—Which may be easily attached to the main road spring of an automobile to steady its action. Patent 1576067. C. A. Rasco, Merca Falls, Calif.

HEADLIGHT.—In which the light itself is hidden and the rays directed downwardly to strike the road, without striking the eyes of approaching drivers. Patent 1576035. E. E. Cipperly, 298 Yosemite Ave., San Jose, Calif.

ROAD VEHICLE.—Of the double bogie type, so constructed as to permit steering with but little effort. Patent 1517193. M. H. Churchill-Shann, 548 Hanel at Albury, New South Wales, Australia.

SPRING SUSPENSE FOR VEHICLES.—For resiliently supporting the body of a vehicle on the axle, and replace the usual vehicle springs. Patent 1576901. A. M. Cowen, 3120 Esplanade Ave., New Orleans, La.

SIGNAL.—Conveniently operable by the driver of a vehicle to indicate his movements without disturbing his control of the vehicle. Patent 1576536. R. S. Parker, 503 So. Hickory St., Ottawa, Kans.

DIRECTION INDICATOR.—Which may be combined with the customary tail light of a vehicle, and include a license plate holder. Patent 1577113. A. De Velasco, 2317 W. 6th St., Los Angeles; Calif.

AUTOMOBILE AWNING.—Which may be attached to the windows, and removed at will, to shade the eyes from the sun rays. Patent 1576886. L. H. Williams, c/o R. L. McDonald Mfg. Co., 12th St. & Penn St., Box 1177, St. Joseph, Mo.

COMBINED FASTENER AND HANDLE FOR AUTOMOBILE DOORS.—Conveniently gripped to simultaneously release the latch and open the door, both ornamental in appearance, simple and durable. Patent 1578118. P. H. Gaskins, 1207 Graham Bldg., Jacksonville, Fla.

REFLECTOR.—For automobile headlights adapted to direct the rays of light so that practically all will illuminate the roadway without producing objectionable glare. Patent 1578079. J. G. Davis, c/o L. L. Thalsheimer, 1408½ Camp St., Dallas, Texas.

ANTISKID CHAIN FOR MOTOR VEHICLES.—Attached to the ends of a bolt positioned through the felly transversly with the tread of a tire. Patent 1577454. C. G. Drescher and C. E. Orrison, c/o Orrison Sales & Service, Villa Grove, Ill.

ELECTRICALLY-HEATED STEERING WHEEL.—Applied to internal portions of the rim, so that heat may be conducted throughout the circumferential portions of the hand grip. Patent 1577987. W. D. Schwenk, Box 133, Ferndale, Mich.

TRACTOR.—Having a novel arrangement of an arch axle and draw bar by means of which either cultivating or plowing implements may be drawn. Patent 1578479. H. A. Stewart and F. L. Holt, 300 E. Leonterdale St., Tullahoma, Tenn.

BRAKE.—For use on automobiles or other vehicles, engines and machinery, utilizing brake shoes instead of the ordinary brake band. Patent 1579100. W. Fraser, Dobbs Ferry, N. Y.

STEERING POST FOR AUTOMOBILES.—That will be more convenient to handle than the posts ordinarily used, and will provide better locking means. G. R. Derr, Santa Margarita, Calif.

TRAFFIC SIGNAL.—Which affords a striking indication of changes in the rate or direction of motion which the driver intends to make. Patent 1578410. C. Elder, 3317 Doniphan Ave., St. Joseph, Mo.

Designs

DESIGN FOR A COAT.—Patent 69571. T. Davis, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A COAT.—Patent 69572. T. Davis, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A DRESS.—Patent 69573. T. Davis, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A DRESS.—Patent 69574. T. Davis, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A TEXTILE FABRIC.—Patent 69600. R. Schey, c/o Max Kaufman & Co., 45 Leonard St., New York, N. Y.

DESIGN FOR A TEXTILE FABRIC.—Patent 69610. R. Schey, c/o Max Kaufman & Co., 45 Leonard St., New York, N. Y.

DESIGN FOR AN AUTOMOBILE FLOWER VASE.—Patent 69681. D. Weller, c/o Moswell Mfg. Co., 68 Grand St., New York, N. Y.

DESIGN FOR A PRINTED FABRIC.—Patent 69674. R. Schey, c/o Nathan H. Rich & Bros., 140 5th Ave., New York, N. Y.

DESIGN FOR A DRESS.—Patent 69687. T. Davis, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A TEXTILE FABRIC OR THE LIKE.—Patent 69696. C. S. Fowler, Westerly, R. I.

DESIGN FOR WRAPPING PAPER.—Patent 69727. R. Wertheimer, c/o Cohn Hale Max Co., 93 Franklin St., New York, N. Y.

DESIGN FOR A STOVE.—Patent 69731. W. F. Allen, c/o Allen Mfg. Co., Nashville, Tenn.

DESIGN FOR A RING OR SIMILAR ARTICLE.—Patent 69809. B. Veit, 935 St. Nicholas Ave., New York, N. Y.

DESIGN FOR AN ELECTRIC LIGHT FIXTURE.—Patent 69797. E. J. Dietzmann, 834 So. Figueroa St., Los Angeles, Cal.

DESIGN FOR A LIQUID DISPENSER.—Patent 69969. W. A. Schatz, c/o Rotax Co., 330 E. 133d St., New York, N. Y.

DESIGN FOR A LAMP MOUNTING.—Patent 69998. A. J. Kollman, 209 E. 59th St., New York, N. Y.

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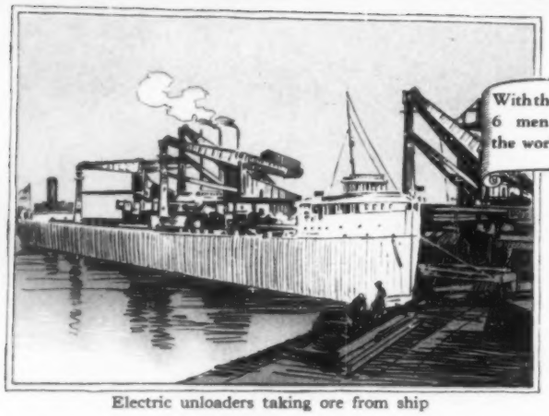


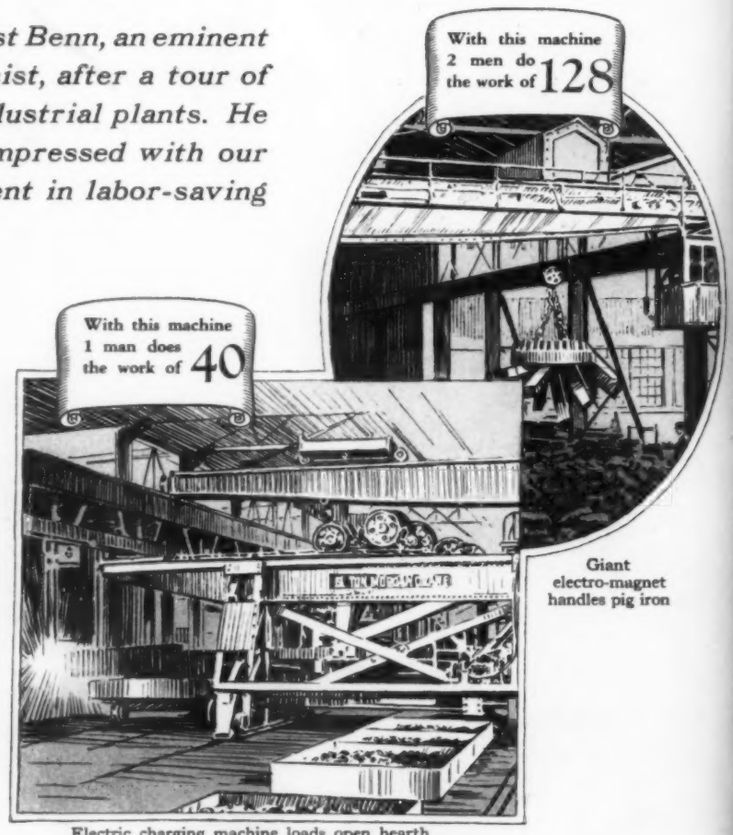
Electric unloaders taking ore from ship

"Nobody lifts anything—*nobody sweats*"

said Sir Ernest Benn, an eminent British publicist, after a tour of America's industrial plants. He was deeply impressed with our vast investment in labor-saving machines.

Electric hoist handles coke

Traveling crane carries hot steel



Giant electro-magnet handles pig iron

Electric charging machine loads open hearth steel furnace

There are in America industries so vast that each would need the man-power of half the nation if there were no machines such as these with their General Electric motors. In every step of manufacture, mining, and forestry, through mill and factory, motors do the manual tasks with great saving of men and money.

For each of the five uses shown above, industry has hundreds of others in which electric motors are helping to increase production by doing the heavy work.

Such ingenious machines to save men's labor are constantly increasing in use. And, wherever electricity is broadly applied, the worker's day is shortened, he is well paid, and he accomplishes much.

GENERAL ELECTRIC